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# Studies in the genus Entorrhiza C. Weber.

By

C. Ferdinandsen and Ö. Winge.

## I. The spore formation in Entorrhiza digitata Lagerh.

A rich material belonging to this species was benevolently sent to us by professor G. Lagerheim in Stockholm. It was fixed in chrom-acetic acid and very well preserved so that microtome cuts, which were stained with Heidenhains hematoxyline, proved good objects for a closer study of the spore formation. The three spore forms as they are described and figured by Lagerheim were found mixed together (cfr. our figures 1, *f*—*n* from Danish material), viz. [1]) some very coarsely and unevenly warted, [2]) some others lower and more evenly warted, while [3]) a third form of spores were entirely smooth and very thick-walled. The shape was always exactly globular and the size varied near 18 $\mu$ in diameter, some few however reaching 30 $\mu$ or more across.

Already P. Magnus (1878) and C. Weber (l. c.) state that the spores in *Entorrhiza* are formed apically on screw-shaped »sterigmata«, and Weber figures these organs in *E. Aschersoniana*, while P. Magnus gives a picture from *E. cypericola*, a copy of which is found in our fig. 8. Using the highest power of the microscrope, however, we saw that the spores in *E. digitata* are formed not on a single »sterigma«, but as a rule by joining of two. The most common case is figured in fig. 1, a, where the two spore-forming filaments are seen like somewhat screwed strings adhering to the ripe spore. In some successful slides we happened to see that the spore no doubt is formed by the working-together of two spiral filaments twining around each other, and that the outside walls of the filaments simply are continued into the spore-

membrane so that the spore must be due to the swelling of the fusing hyphae (fig. 1, *b*—*c*). Very often, however, the screw-height of the spiral is so small and the filaments moreover have the

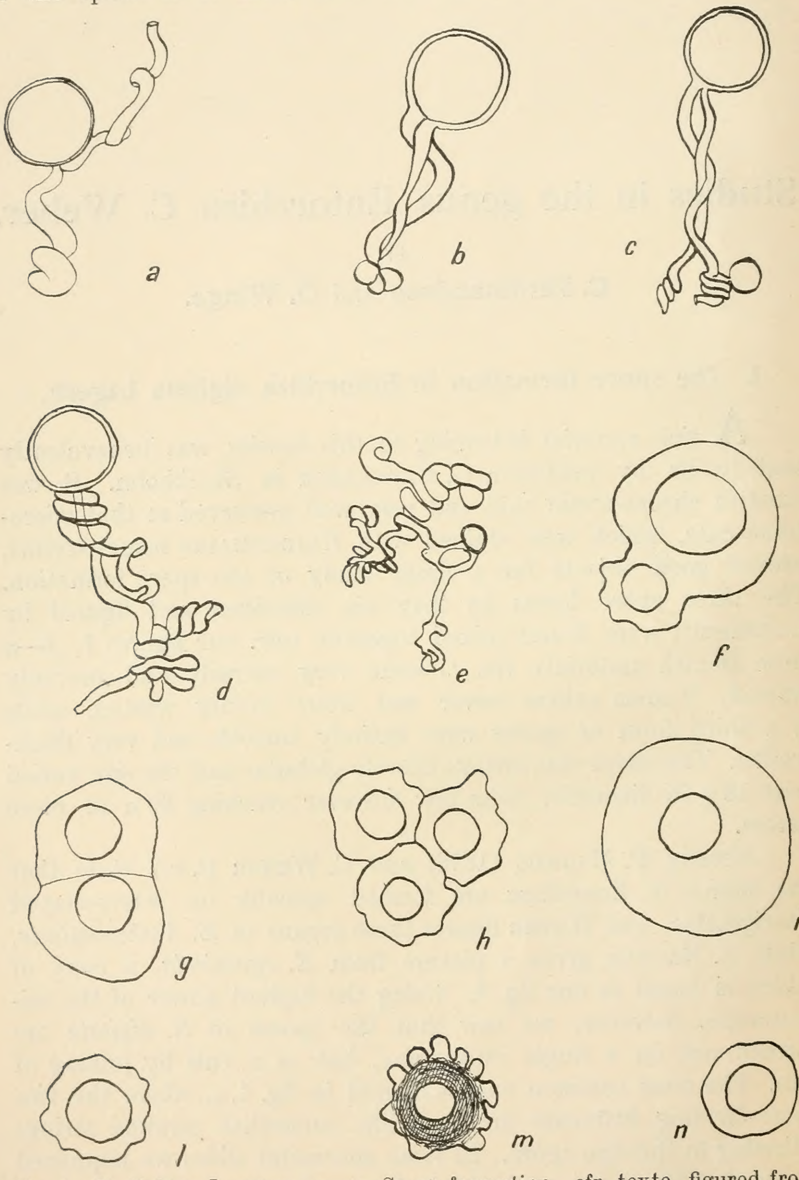


Fig. 1. *E. digitata* Lagerh. *a*—*e*: Spore formation, cfr. texte, figured from material communicated by prof. Lagerheim. *f*—*n*: Various forms of spores and spore complexes, figured from material, collected by Nordby on Fanø, see pg. 7. *a*—*e*: about $\frac{1300}{1}$; *f*—*n*: $\frac{600}{1}$.

plasm so dense and refractive that it is almost impossible to decide, whether a single or two filaments take part in forming the spiral.

From our observations we are justified in concluding the following: The spore originates from two spiral filaments fusing together, which at least in many cases are twined around each other, while in other cases it is probable that they fuse without twining. The spiral threads themselves are coming from very complex hyphal bundles and may often be branched (fig. 1, *d—e*). Sometimes two spores are formed connected to each other, so the double-spore strikingly is resembling a teleutospore of a *Puccinia* (fig. 1, *g*). In other cases three spores are growing together forming a row or a *Triphragmium*-like complex (fig. 1, *h*), and also four spores are observed in connection. Rarely one of the two spores forming a »Puccinia« has a smooth membrane, while the other one is coarsely warted (fig. 1, *f*). In no case we have happened to see a spore with only one adherent spiral string; this circumstance naturally by no means excludes the possibility of the spore being formed by a single filament, but at least it is the rule that two spiral filaments directly take part in the spore formation, a phenomenon, which reminds of the ascus formation in the genus *Eremascus*.

## II. The systematic position of the genus Entorrhiza.

The genus *Entorrhiza* has always been considered by the authors as a relative to the Ustilagineae, until Brefeld (1912, p. 80) brings forward the opinion that the fungus probably must be regarded as a *fungus imperfectus* belonging to the Ascomycetes, the ascus-form of which is still unknown. In the said paper Brefeld has proved indisputably that an »*Ustilago*« on *Panicum crus ardeae* Willd.[1]) from South America really is a conidial stage of a *Claviceps*-like Hypocreacea, viz. *Ustilaginoidea* Bref., the existence of which he already several years ago had profezied. Further he is probably justified in his conclusion that the morphologically thoroughly like *Ustilago virens* Cke. (= *Tilletia Oryzae* Pat.) on rice belongs to the same genus. Brefeld, however, is going still farther in so far as he, as it appears less convincing, also classifies the genera *Entorrhiza* Weber and *Schroeteria* Wint. as *fungi imperfecti* among the Ascomycetes. He is led to this

[1]) By Brefeld »*Panicum crus Urdeae*«, probably erroneous for the said species.

supposition mainly by studying the manner of spore germination. He has namely found in both genera that the spores are germinating into short flash-shaped sterigmata on the top of which are formed basipetal chains of conidia, a fact stated for *Schroeteria* long ago, but until then not observed in *Entorrhiza*. This manner of germination into »*Acrostalagmus*-like« conidia, which was observed by Brefeld in the species *Entorrhiza Aschersoniana* (Magn.) De Toni, *E. cypericola* (Magn.) De Toni, *Schroeteria Delastrina* (Tul.) Wint. and *S. parvispora* Bref. might point, undeniably, towards a relationship to the Ascomycetes, but Brefeld seems not to take in consideration nor at least to lay stress upon the fact that previous investigators have observed that the spores of the genera in question can germinate in an ustilaginoid manner. Thus Winter (l. c. p. 147) has found that *Schroeteria Delastrina* may germinate into a *Tilletia*-like promycelium, and Weber states l. c. that the germination of *Entorrhiza Aschersoniana* is going on in that way that the spore sends out several hypha-like promycelia which again produce falcate sporidia, as well laterally as apically, thus putting in mind the germination of a *Proustilago*. These facts point clearly towards a relationship to the Ustilagineae, and so it may be reasonable to believe that the germination into »*Acrostalagmus*-like« conidia is a phenomenon of secondary importance.

In fact, the morphological likeness between the genera *Entorrhiza* and *Schroeteria* and, on the other side, the conidial stage of *Ustilaginoidea*, is not very great: The greenish *Sepedonium*-like chlamydospores of the last fungus are formed on the surface of a solid central pseudoparenchyma, which in some cases can appear as a real sclerotium, a circumstance, which in connection with the occurrence of the fungus in the ovaries of grasses, puts in mind a *Claviceps*-like organism — while on the other hand *Schroeteria* and *Entorrhiza*, owing to their perishable hyphae and the formation of entirely dust-like spore-masses, resemble the true Ustilagineae.

As to the genus *Entorrhiza* the spore-formation in *E. digitata*, described above, furthermore seems to be like that of the Ustilagineae in several respects. In this group cell-fusions by deliquescence of the membranes are commonly occurring during the spore formation, and recently F. Rawitscher has shown that the young binucleate spore cell in *Ustilago Maydis* results from the dissolving of a wall between two uninucleate neighbour-cells. Further the intricately entangled hyphal complexes, wherefrom the sporogene

hyphae originate in *Entorrhiza digitata*, have a striking likeness with the corresponding organs in the true Ustilagineae, not least by the marked deliquescence of the filaments (fig. 1, *e*).

Concerning the cytology of the Ustilagineae Dangeard, Lutman and Rawitscher l. c. have shown that a syncaryon-stage is established earlier or later during the ontogenesis, the young spores obtaining always two nuclei which later on fuse together

Fig. 2. *E. Raunkiæriana* sp. n. *a—b*: Spores with few rather distinct nuclei. *c—e*: Spores with numerous chromatin bodies in the cytoplasm. $\frac{2400}{1}$.

within the spore. — As to *Entorrhiza* we have not succeeded in making out its cytology, but in several cases we have seen that the spores as well in *E. Raunkiæriana* sp. n. (fig. 2, *b*) as in *E. digitata* have two rather distinct nuclei. Often, however, the nuclear elements have another appearence. Thus, in *E. Raunkiæriana*, three or more nucleus-like organs (fig. 2, *a*) are to be seen in the cytoplasma, but mostly distinct nuclei are not present, a number of chromatin bodies being scattered all around in the

plasm, without nuclear membrane, and connected to each other with linin threads (fig. 2, *c—e*)[1]).

In conclusion it seems to be justified — in spite of the »*Acrostalagmus*-like« germination — to place *Entorrhiza* and probably also *Schroeteria* in the neighbourhood of the Ustilagineae. Especially *Entorrhiza* might be considered as a primitive type of the said group on account of the morphologically well marked copulation observed by us by the spore formation in *E. digitata* — and further the *Proustilago*-like germination stated by WEBER in *E. Aschersoniana*. It is in accordance with this view that all the species of this genus live in the soil and spread their spores by aid of the water, while the genuine Ustilagineae are adapted to an aërial life.

## III. The genus Entorrhiza in Denmark.

**E. Aschersoniana** (Magn.) de Toni.

Syn.: *E. cypericola* Weber e. p., *Schinzia Aschersoniana* Magn.

On revising the material available in the collections of the Botanical Museum of the Copenhagen University, all collected on *Juncus bufonius*, we found the spores always being elliptical with regular sculpture and thus distinctly differing from the spherical, coarsely and unregularly warted ones in *E. Casparyana* (MAGN.) DE TONI (fig. 8). In some cases we have observed the spores being provided with adherent screwed filaments and channels (germination pores?) through the walls. We have found the spores more varying and as a rule bigger than stated by P. MAGNUS (1888, p. 103), who has measured them 15—17 $\asymp$ 11—15 $\mu$. SCHROETER (1889, p. 290) states 17—20 $\asymp$ 15—17 $\mu$. In the following all the Danish localities hitherto known are enumerated.

*Sealand:* Charlottenlund, field sloping towards the sea. July, 1885 (E. ROSTRUP). Spores yet immature. A single one $17^1/_2 \asymp 15\,\mu$.
Constantia, Aug. 14, 1885 (E. ROSTRUP). Sp. 16—22 $\asymp$ 12—18 $\mu$.
Rorvig, June 21, 1914 (C. FERDINANDSEN). Sp. immature, $17^1/_2 \asymp 15\,\mu$.

*Jutland:* Randboldal, Sept. 12, 1885 (E. ROSTRUP). The material destroyed. A single spore 20 $\asymp$ 15 $\mu$.

[1]) In this connection we can state that in *Schroeteria Decaisneana* (BOUD.) DE TONI we have seen as a rule two nuclei in the young spores, a single or three though being also observed (c. 60 % : 2 nuclei, c. 30 % : 1 nucleus, c. 10 % : 3 nuclei).

Treldeskov, July 9, 1886 (E. Rostrup). Spores 19—24 ⨯ 16—21 μ.

Klitmøller, July 1894 (E. Rostrup). The more coarsely warted spores 20—22 ⨯ $17^1/_2$—19 μ.

Further Lind (l. c. p. 271) reports: Sæby (E. Rostrup) and Frederikshavn (Lind).

*Bornholm:* Lind (l. c. p. 271) reports: Almindingen (E. Rostrup).

### E. digitata Lagerh.

To this species must be referred three numbers, all collected by dr. C. H. Ostenfeld on the western coast of Jutland. The two numbers (Fanø and Tværsted) were found on a plant of the *Juncus articulatus*-group, which dr. Ostenfeld believes to be a distinct form of *Juncus alpinus* Vill. He has friendly communicated to us that the infected specimens of this *Juncus* on the Fanø-locality grew mixed together with plants of *J. atricapillus* Drej. and *J. lamprocarpus* Ehrh. without these two species being found infested by the fungus. The third specimen of this *Entorrhiza* was found on a seedling of a *Juncus articulatus* s. lat. impossible of a closer determination; on the locality (the lake Ferringsø near Bovbjerg) the *Juncus alpinus*-form in question may very well occur, and it is thus probable that we also here are dealing with this plant. Lagerheim l. c. gives as host-plant *J. articulatus.* Judging from the localities (Titisee Germaniae, Pontresina Helvetiae) it is probable that under this collective species-name is hidden a *Juncus alpinus*-form, the *Entorrhiza*-species showing to be very specialized to single species of host-plants.

In the following are given the localites and some details of the fungus.

*Jutland:* Ferringsø, July 1893. On a seedling of »*Juncus articulatus*« (C. H. Ostenfeld). Lind (l. c. p. 271) reports this specimen as *Entorrhiza Aschersoniana* on *Juncus bufonius* in accordance with a label written by the late prof. E. Rostrup. Spores as described in the specimens from Fanø, $17^1/_2$—22 μ diam.

Tværsted, strand dune, Aug. 10, 1912. On *Juncus alpinus* Vill. forma (C. H. Ostenfeld). Exactly agreeing with the following.

Fanø, near Nordby, Oct. 15, 1912. On *Juncus alpinus* Vill. forma (C. H. Ostenfeld).

In the specimens from the last named locality the tumours were found to be now cylindrical, entire, now more or less palmate. Spores spherical, pale yellowish-chestnut according to the advancing maturity, as a rule 20 $\mu$ across, many lesser, some bigger, some others gigantic, until 45 $\mu$ across, the wall then being exceedingly thickened (fig. 1, *i*). The shape of the membrane is very varying. In some cases the membrane is entirely smooth and then commonly being very thickened, often about 10 $\mu$, surpassing the diameter of the lumen. The membrane of the above mentioned gigant-like spore was about 18 $\mu$ thick. In other cases the spores are provided with very long (about 5 $\mu$), obtuse or flattened warts being irregularly distributed on the surface of the membrane, putting in mind the sculpture of the *E. Casparyana*-spore (fig. 1, *m* and fig. 8). Finally some spores are more regularly and lower warted (fig. 1, *l*). On studying more thoroughly the material, one often finds two or more spores connected with each other in a *Puccinia-* or *Triphragmium*-like complex (fig. 1, *f*—*h*) or seldom in a row composed of some few spores. Often we have seen channels going through the thickened walls.

**Entorrhiza Raunkiæriana** Ferd. et Wge. sp. n.

Mycocecidiis ex apicibus radicum tenuium tumefactis oriundis, oblongo-citriformibus vel ovoideis, formam siliquae *Crambes maritimae* L. saepe aemulantibus, maximis 3 mm latis, albo-flavidis. Sporis in hyphis hyalinis, diu persistentibus acrogenis, $\pm$ protracte ellipsoideis, citriformibus, plerumque 18—21 $\mu$ long. $\simeq$ 9—11 $\mu$ lat., nonnullis usque ad 30 $\mu$ elongatis, hyalino-flavidulis, plasmate denso, nonnumquam vacuolato farctis, episporio lineolis spiralibus, circ. 2 $\mu$ inter se distantibus, dextrorsum oblique ascendentibus ornato suffultis.

In radicibus *Scirpi fluitantis* L., in stagno dunensi Grøndal dicto insulae Danicae Fanø submersi, mense Octobri. (Leg. C. Raunkiær).

This fungus, which by J. Lind (l. c. p. 271) is identified with *E. scirpicola* (Correns) Sacc. et Syd., was already found in the year 1896 by prof. C. Raunkiær in a little dune-lake, Grøndal, on the island of Fanø, and was refound Septbr. 1911 and Oct. 1912 in the same locality. A great many roots of *Scirpus fluitans* submerged outside the *Agrostis canina*-community were infested by the fungus. — Spores collected in Oct. were wintered at a low room temperature, apparently without changing their aspect. As

late as March 10 the curved appendix persisted in nearly all the spores, and no germination was to be seen.

As to be exspected the species has a considerable resemblance to *E. scirpicola* on *Scirpus pauciflorus* Lightf., but differs distinctly from this as well by the shape of the tumours as by the spore-form. In *E. scirpicola* the tumours are cylindrical (fig. 5) while in our species ovoid or often constricted as the silique of *Crambe maritima* L. (fig. 3). Further the spores in *E. scirpicola* are less slender (16—20 $\asymp$ 11—14 $\mu$) than in *E. Raunkiæriana* (18—21 $\asymp$ 9—11 $\mu$), the proportion between length and breadth of the spores in the two species thus being respectively 1,5 : 1 and 1,9 : 1 (fig. 4 and 5). We have not succeeded in procuring type-specimens of *E. scirpicola*, but still we have had occasion to examine this species; in the collections of the Botanical Museum of the Copenhagen University are found, namely, specimens of the fungus on *Scirpus pauciflorus* from the Færøes (Trangisvaag on Suderø, leg. C. H. Ostenfeld); E. Rostrup (1901, p. 306) identified the plant with *E. cypericola* (Magn.) De Toni. In these specimens, though being very young, so that the spiral lines of the spore-membrane just are going to appear, the proportion between length and breadth of the spores still is exactly as stated by Correns, the young spores measuring 15 $\asymp$ 9 $\mu$.

Fig. 3. *E. Raunkiæriana* sp. n. Tumours in roots of *Scirpus fluitans* L. About nat. size.

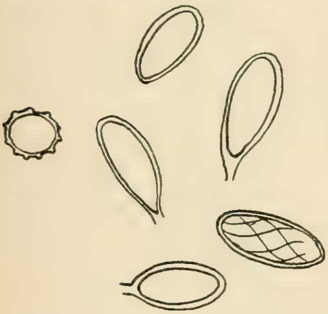

Fig. 4. *E. Raunkiæriana* sp. n. Spores, one of which showing in optical section the outer structure of the membrane, and another showing the same structure in transverse section. Cfr. fig. 2. $\frac{700}{1}$.

The record of this fungus from the Færøes, being so far away from the hitherto only known locality, Val Maggia, Tessin, Switzerland, suggests the opinion that the distribution of the *Entorrhiza*-species is coincident with that of their host-plants and that the species are closely specialized to single

Fig. 5. *E. scirpicola*, (Correns) Sacc. & Syd. *1—3*: Rootswellings on *Scirpus pauciflorus* Lightf.; *4—5*: Spores from above and from the side; *6*: Spore from above, treated with conc. $H_2SO_4$. *1—3*: $^1/_1$; *4—6*: $\frac{500}{1}$. After C. Correns.

host-species. In this connection the above statement under *E. digitata* might be brought to memory, and further that the hitherto known *Entorrhiza*-species, which seem to be distinctly different, every one is confined to a single host-species.

The two species of *Entorrhiza* growing on *Scirpus* are both characteristic by having spiral lines on the spore-membrane, in this regard differing from the other species of the genus. As stated above they are, however, morphologically well separated, a circumstance, which was likely to be found, partly because the *Entorrhiza*-species upon the whole are strongly specialized to their host-plants, and mainly according to the fact that the host-species in question belong to different subgenera, *S. pauciflorus* being an *Euscirpus*, while *S. fluitans* belongs to *Isolepis* and even by Link is referred to a particular genus, *Eleogiton*.

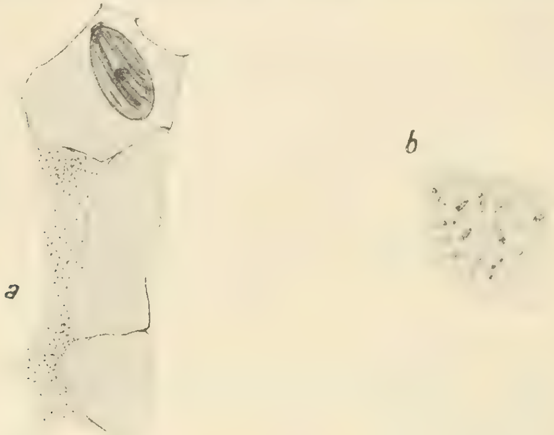

Fig. 6. *a*: Bark cells from a root of *Scirpus fluitans* L., infested by *E. Raunkiæriana* sp. n. In one cell is seen a spore of the named fungus, in another numerous bacteria. $\frac{700}{1}$. *b*: The bacteria higher magnified. These bacteria were commonly found in our material.

### **Entorrhiza caricicola** Ferd. et Wge. sp. n.

Aggressu fungi, qui apices radicum tenuium infestat, tumoribus piriformibus vel oblongo-piriformibus, levibus, maximis 3—4 mm. longis et 1—2 mm. latis, albidis oriundis. Sporis in hyphis hyalinis, deliquescentibus, plerumque tortis acrogenis; episporio primum levi, hyalino, indumento gelatinoso instructo, ad maturitatem, contractione strati gelatinosi, subtiliter ruguloso-undulato, dilute flavidulo. Sporis maturis oblongo-ellipsoideis vel protracte obo-

voideis, saepius inaequilateralibus, ad insertionem stipitis applanatis, 22—26 $\mu$ long. $\asymp$ 12—16 $\mu$ lat., plasmate denso, vacuolato farctis.

In radicibus tumefactis *Caricis limosae* L. in palude Lyngby Mose dicta Selandiae septentrionalis, mense Septembri. (Leg. F. Kølpin Ravn).

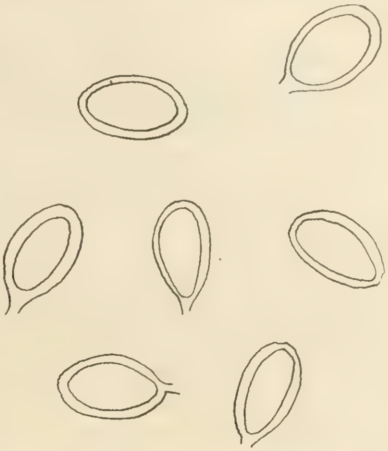

Fig. 7. *E. caricicola* sp. n. Spores $\frac{600}{1}$.

E. Rostrup (1894, p. 36) mentions this discovery and identifies the specimens collected with *E. cypericola* (Magn.) De Toni parasiting in the roots of *Cyperus flavescens* L. Yet he adds: »The form found on the said *Carex* differs, however, as to the size and structure of the spores somewhat from the description given by P. Magnus, it therefore possibly being a distinct species, which must be verified by direct comparison and culture experiments. The spores are somewhat larger than those of Magnus, being namely 20—25 $\asymp$ 12—15 $\mu$«.

In fact, the morphological difference between the two species is rather great, as well regarding the shape of the spore as the sculpture of the membrane, which has been evident to us by examining specimens of *E. cypericola* from the classic locality. We found the size of the spores agreeing with the statement of P. Magnus (17—20 $\asymp$ 11—14 $\mu$), wherefrom it thus becomes evident that the spore in *E. cypericola* is relatively considerably broader than in *E. caricicola*, the proportions between length and breadth being respectively 1,4 : 1 and 1,7 : 1 (fig. 7—8). Further the membrane in *E. cypericola* is thicker and more coarsely sculptured than in our species. We can state that by examining *E. cypericola* we often have found the spores provided with two adherent filaments, and that we also in this

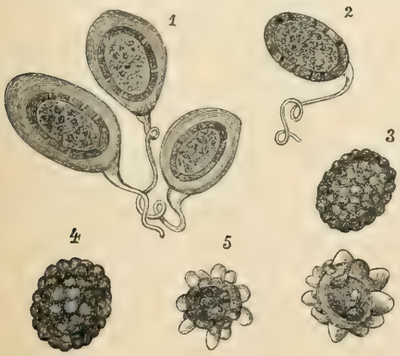


Fig. 8. Spores of: *1—2*: *E. cypericola* (Magn.) De Toni; *3—4*: *E. Aschersoniana* (Magn.) De Toni; *5—6*: *E. Casparyana* (Magn.) De Toni. c. $\frac{650}{1}$. (After P. Magnus).

species have observed two spores connected into *Puccinia*-like complexes.

*Entorrhiza caricicola* sp. n. which is the only *Entorrhiza*-species known on the genus *Carex*, is found on *Carex limosa* L. in a bog near Lyngby in the northern Sealand, first by prof. F. Kølpin Ravn in Septbr. 1893, later by dr. C. H. Ostenfeld »in radicibus *Caricis limosae* inter muscos; Selandiae, Lyngby, in turfosis. 27. 10. 1895«.

By J. Lind (l. c. p. 271) the fungus is enumerated under the name adopted by E. Rostrup: *E. cypericola* (Magn.) De Toni.

## IV. The species of the genus Entorrhiza.

The genus *Entorrhiza* was founded by C. Weber in 1884 (l. c) upon the *Juncus bufonius-Entorrhiza*, *E. Aschersoniana* (Magn.) De Toni, which thus must be considered as the type species. It is the merit of P. Magnus, however, to have signalized to science the first species of this genus in that he already in 1878 published his *Schinzia cypericola* (1878, p. 53); this mycologist namely was of opinion that his fungus belonged to the genus *Schinzia* founded by K. Nägeli in 1842 (l. c., p. 281) on *Schinzia cellulicola* in the roots of *Iris* sp.

Whatewer it may be one must maintain that the belonging together of the two last named species is very doubtful, because Nägeli in his description and figures of *E. cellulicola* omits some features exceedingly characteristic of the genus *Entorrhiza*. Further the integrity of the genus *Schinzia* has been shaken by authors who have referred quite heterogeneous elements, viz. *Schinzia Alni* Wor. and *S. Leguminosarum* Frank, to this genus.

The point of view being justified that *Schinzia cellulicola* Näg. is not a true *Entorrhiza* and considering furthermore the *E. Solani* Fautrey (l. c.) as problematic, the genus *Entorrhiza* thus shows to be confined only to glumiflorous host-plants, even if the tumours of the plants mentioned by P. Magnus (1888, p. 104) might turn out to be produced by fungi belonging to this genus.

In conclusion the following organisms must be considered as true *Entorrhiza*-species:

On *Juncaceae*:

*E. Aschersoniana* (Magn.) De Toni (*Juncus bufonius* L.).
*E. Casparyana* (Magn.) De Toni (*Juncus Tenageja* Ehrh.).
*E. digitata* Lagerh. (*Juncus articulatus* L. coll., probably always *J. alpinus* Vill.).

Further C. B. PLOWRIGHT (l. c., p. 299) and E. ROSTRUP (1901 p. 306) state the presence of an *Entorrhiza* in the roots of *J. lamprocarpus* EHRH.

On *Cyperaceae*:

*E. cypericola* (MAGN.) DE TONI (*Cyperus flavescens* L.).
*E. scirpicola* (CORRENS) SACC. et SYD. (*Scirpus pauciflorus* LIGHTF.).
*E. Raunkiæriana* sp. n. (*Scirpus fluitans* L.).
*E. caricicola* sp. n. (*Carex limosa* L.).

Probably several other glumiflores will show to be host-plants to *Entorrhiza*-species — e. g. the plants with root-swellings enumerated by P. MAGNUS (1888, p. 104) after a statement of P. CAMERON, viz.: *Juncus squarrosus* L., *J. uliginosus* ROTH and *Eriophorum vaginatum* L.

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# The marine Algæ of the Danish West Indies.
## Part 2. PHÆOPHYCEÆ.

By

**F. Børgesen.**

### INTRODUCTION

As in the case of my *Chlorophyceæ* paper the present communication is based upon material collected during my three stays at the islands.

With regard to the collecting of the algæ, reference should be made to the introduction to the *Chlorophyceæ* section for information as to the localities visited and for physiographical details. Here also a chart showing the coral reefs, depths etc. in the sea nearest the islands is published.

Concerning the brown algæ from the islands I have already published some papers on the subject, namely:

Two crustaceous brown algæ from the Danish West Indies (Nuova Notarisia, Serie XXIII, Luglio 1912).

The species of *Sargassum* found along the coasts of the Danish West Indies with remarks upon the floating forms of the Sargasso Sea (Mindeskrift for Japetus Steenstrup, København 1914).

For the sake of completeness I also give here the contents of these paper so far as they treat with the fixed algæ living at the shores of the islands.

If we compare the brown algal vegetation of the West Indian islands with that found in northern seas we see clearly the well known fact that the northern brown algal vegetation reaches a luxuriancy which greatly surpass that in the tropics. The group of brown algæ which in the islands is most vigorously developed is the *Fucaceæ* represented by *Sargassum* and *Turbinaria*, and where these are growing in full vigour this tropical *Fucaceæ*-Formation is not much inferior to that found in the northern sea,

e. g. at the shores of the Færöes[1]). But this fucaceous vegetation is also the most vigorously developed and as is well known the corresponding vegetation in the northern seas is much behind the vegetation of the *Laminariaceæ.*

After the *Fucaceæ* it is the representatives of the *Dictyotaceæ* and also forms of the *Encœliaceæ* which attain to some size and are found in greater masses in the West Indies, apart from these most of the forms are small. Upon stones in shallow water brown crusts of *Ralfsia expansa* are common and upon rocks on the north west coast of St. Croix *Aglaozonia canariensis* forms large red brown expansions.

As to the number of species found at the shores of the islands (40 species) this is also not great; compared with that found at the shores of the Færöes (73 species) it is only a little more than half.

The brown algæ occur from low water mark (the tide is nearly wanting at the islands) or a little above, and down to a depth of about 40 meters where *Zonaria variegata* was still found well developed; as mentioned in the introduction to the *Chlorophyceæ* section I have not been able to dredge in greater depth.

With regard to the earlier contributors to our knowledge of the algæ of the islands I refer to the information given in the *Chlorophyceæ*, just as in the case of collectors of algæ etc.

Here I wish only to express my best thanks to the botanists who in different ways have helped me by the working out of the present paper.

I am much indebted to M^me^ Weber-van Bosse and Professor C. Sauvageau for having been so kind as to send me original specimens of different species to compare with the mine.

And especially my thanks are due to Professor P. Kuckuck who by reason his extensive knowledge especially of the *Phæosporeæ* has been able to give me much valuable information.

Finally, I am much obliged to the Direction of the Carlsberg Fund for the grant in aid of the drawings and reproduction.

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[1]) Comp. F. Børgesen, The Algæ-vegetation of the Færöese coasts, 1905. (Botany of the Færöes, Part III).

# PHÆOPHYCEÆ

## I. Phæosporales.

### *Fam. 1.* ***Ectocarpaceæ.***

### **Ectocarpus** Lyngb.

**1. Ectocarpus Duchassaingianus** Grun.

GRUNOW, A., Algæ, in »Reise der Österreichischen Fregatte Novara um die Erde«, Botan. Theil, 1ster Bd., 1870, p. 45, tab. IV, fig. 1.

VICKERS, A., Phycologia Barbadensis, Part. II, tab. 27.

To this species of GRUNOW I have referred an *Ectocarpus* which seems to agree with it very well even if there are a few differences.

It occurs as rather large 2—4 cm high tufts growing epiphytically upon other algæ or on stones, piles and similar substrata in harbours or bays.

The basal part consists of rather thick-walled, yellow-brown, irregularly bent and ramified, rhizoid-like filaments woven together (Fig. 2 *a*). From this basal part the erect filaments grow up. At first the filaments increase by division of all the cells but soon marked intercalary growth takes place (comp. Fig. 1 and 2 *c*); the filaments terminate in rather long, nearly colourless hairs, the uppermost cells of which reaching a length of 5—6 times their own breadth. Elsewhere the cells in the filaments are 1—2, sometimes even 3 times, as long as broad. The diameter of the cells reaches 20—22 $\mu$.

The ramication is spreading and very irregular; often large parts of the filaments are not ramified at all (Fig. 1).

The chromatophores consist of small, irregularly shaped discs, often roundish, or in the younger cells, oval (Fig. 2 *g*).

The plurilocular sporangia are as a rule sessile (Fig. 1 and Fig. 2 *b*, *c*), occasionally they are found ending a short branch (Fig. 2 *e*). They are very variable in size and form; sometimes long and nearly cylindrical (Fig. 2 *b*), sometimes short and often clavate and with walls more or less undulating. They may reach a length of more than 250 $\mu$, most commonly they are only the

half this length; their diameter may reach 50 $\mu$, but is usually about 25—27 $\mu$.

The unilocular sporangia (Fig. 1, Fig. 2 *f*) are obovate-oval, sessile, attaining a length up to 110 $\mu$ and a breadth of about 70 $\mu$.

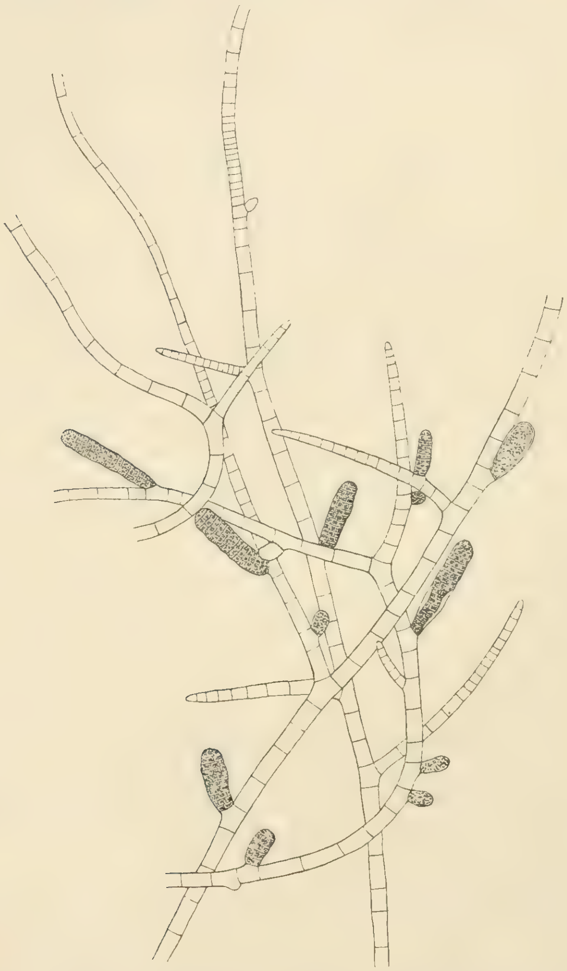

Fig. 1. *Ectocarpus Duchassaingianus* Grun.
Filaments with plurilocular sporangia and a single unilocular.
(About 90 : 1).

The present species was found with both kinds of sporangia in the months December—March.

This species seems to be nearly related to *Ectocarpus indicus* Sonder (comp. the figure given by M^me^ Weber in "Algues du

Siboga", I, 1913, p. 130) and to *Ectocarpus simpliciusculus* of Askenasy (Alg. Gazelle, p. 20, tab. V, fig. 1, 11) which, as pointed out by Mme Weber, most probably belongs to *Ectocarpus indicus*. Mme Weber does not mention the shape of the chromatophores of

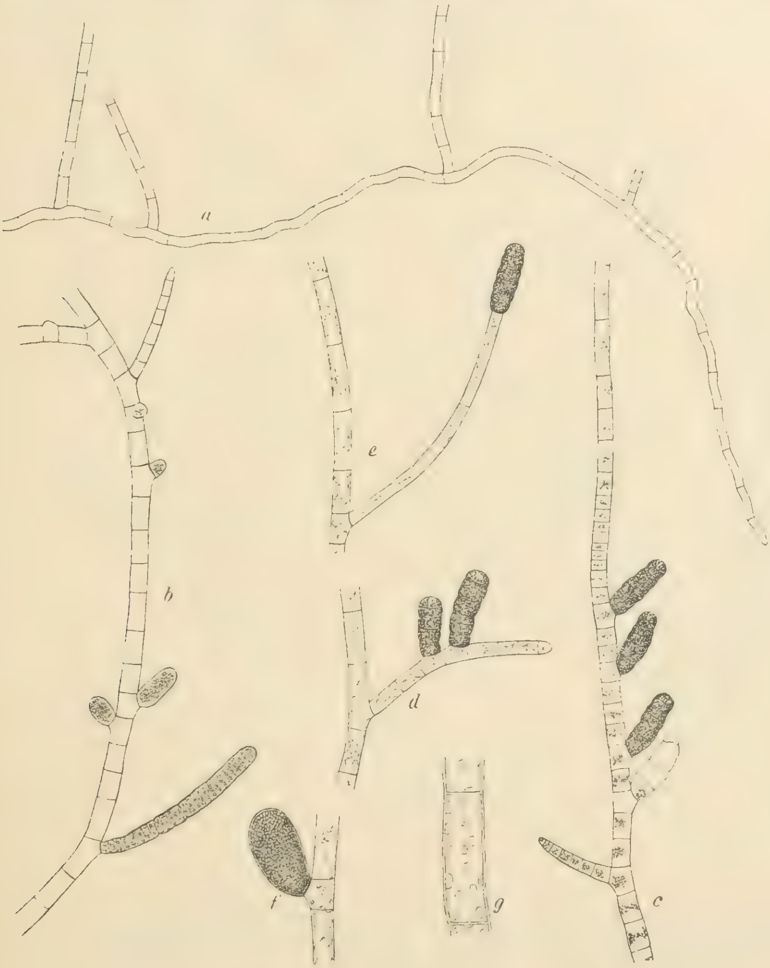


Fig. 2. *Ectocarpus Duchassaingianus* Grun.
*a*, basal, creeping filament. *b*, filament with a long, cylindrical plurilocular sporangium and unilocular sporangia. *c*, plurilocular sporangia placed upon the main filament. *d*, plurilocular sporangia upon a branchlet. *e*, a terminal, plurilocular sporangium. *f*, an unilocular sporangium. *g*, cell with chromatophores. (*a*, about 50 : 1; *b*—*e*, about 90 : 1; *f*, about 140 : 1; *g*, about 225 : 1).

*Ect. indicus*; if these agree with those of *Ect. Duchassaingianus* I think the latter is merely a form of the former.

It grows in the littoral and uppermost part of the sublittoral region, most often in sheltered places, but also in more exposed and seems to be a common species.

It was found, St. Croix: Christiansteds Harbour and in the lagoon near this town. St. Thomas: The Harbour in several places. St. Jan: Cruz Bay and off America Hill in a depth of about 20 metres.

Geogr. Distrib. West Indies.

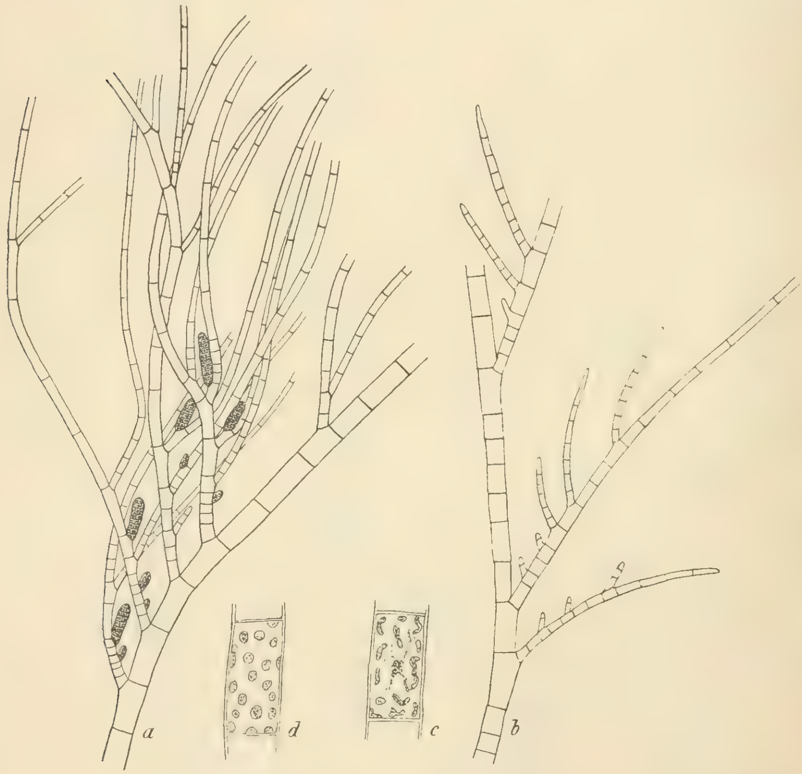


Fig. 3. *Ectocarpus Mitchellæ* Harv.
*a*, part of thallus with plurilocular sporangia. *b*, part of thallus with young branchlets. *c*, chromatophores in a young cell. *d*, chromatophores in an older cell. (*a* and *b*, about 100 : 1; *c* and *d*, about 200 : 1).

## 2. Ectocarpus Mitchellæ Harv.

Harvey, Nereis Boreali-Americana, Part I, p. 142, pl. XII, G.

The specimens referred to this species form two—three cm and higher tufts.

From the lowermost cells in the filaments rhizoids grow out (Fig. 4), fixing the filaments to the substratum, stones, shells

or larger algæ, e. g. *Codium*. The rhizoids are about 11 $\mu$ thick and consist of proportionately long cells.

In the basal part the main filaments are thinner, reaching only a thickness of about 22 $\mu$; higher up they grow thicker, the diameter of the cells here being from 35—45, seldom 50 $\mu$, while their length is about 2—3 times as long. In the upper part of the thallus the filaments become thinner again, the cells at the same time becoming proportionately longer.

The cells are cylindrical or sometimes very slightly barrelshaped; in the lower part of the thallus their walls are often brownish coloured.

The lowermost parts of the main filaments are not ramified; higher up branches grow out from almost every cell, most often in a secund manner (Fig. 3 *a*), sometimes alternating. The young branches are somewhat attenuated towards their apex (Fig. 3 *b*) and composed of cells which are somewhat longer upwards and have fewer chromatophores. Later on the branches show a marked growing point near their base and terminate with long nearly colourless hairs (Fig. 3 *a*). The branches are about 15—20 $\mu$ thick, the hairs 10—15 $\mu$.

The chromatophores (Fig. 3 *c*, *d*) have the shape of short ribbons in the young cells, in the older they are small roundish discs[1]).

Upon their upper side the branches again bear smaller ones also terminating with hairs and further plurilocular sporangia (Fig. 3 *a*). These are developed successively upwards from the growing point in perfect accordance with those in *Ectocarpus virescens* as pointed out by SAUVAGEAU[2]). The plurilocular sporangia are sessile, lanceolate cylindrical, with obtuse

Fig. 4. *Ectocarpus Mitchellæ* Harv. Base of a plant. (About 100 : 1).

[1]) Comp. SAUVAGEAU, C., Sur l'Ectocarpus virescens Thuret, (Journal de Bot., T. X, 1896, p. 101, fig. 2 *B*, *C*).

[2]) SAUVAGEAU, l. c., p. 101, fig. 2 *A*.

apex and base, reaching to a length of about 70—100 $\mu$, and a breadth of 15—20 $\mu$.

Unilocular sporangia were not found.

Harvey's description and figure of this species being not sufficiently good for an absolutely certain determination to be made I have been very thankful to receive from Professor Sauvageau some fine preparations of Harvey's original plant. Compared with these my plant shows some differences, the most essential of these being that the hairs in the West Indian plant are more richly developed and the ramuli not so much attenuated as in the original plant; in the latter also the cells seem to be somewhat more barrelshaped, while in mine they are most often quite cylindrical. But I do not think that these differences are of sufficient importance to separate my plant from Harvey's.

As is well known it is rather doubtful how far *Ectocarpus virescens* Thur. is a distinct species from that of Harvey. Of this species also Prof. Sauvageau has been so kind as to send me not only specimens from Herb. Thuret, but also some collected by himself at Guéthary, one of which has plurilocular sporangia with large spores, and other with small spores.

Having compared these specimens with mine and also with Harvey's plant I find that while the shape of the sporangia agree well in all the specimens, the French material has more attenuated branchlets and not such well developed hairs as in mine. In this respect they agree with Harvey's. But in the American plant and so also in mine we have not yet found more than a single kind of plurilocular sporangia. Furthermore *Ectoc. Mitchellæ* becomes somewhat more brownish in colour when dry and seems also to be somewhat more rigid and robust as the whole.

At the Danish Islands this species was found in somewhat exposed localities in the upper sublittoral region.

St. Thomas: Several places in the harbour, Store Nordside Bugt.
Geogr. Distrib. Atlantic coast of North America.

### 3. **Ectocarpus coniferus** nov. spec.

Ectocarpus mediocris, axi primario distincto, filamentis erectis, rhizoideis brevibus substrato adfixis, ca. 40 $\mu$ crassis, articulis $^1/_2$ usque 4 plo longioribus quam latioribus, in parte basali simplicibus, dein ramosis ramis irregulariter dispositis, interdum alternis, secundis aut sparsis, curvatis, apicem versus attenuatis in pilum longum articulatum productis.

Sporangia plurilocularia plerumque axillaria, sessilia, dense aggregata, conico-elongata, magnitudine variabili, minora = 40 μ long. et 24 μ lat., majora = 110 μ long. et 40 μ lat., plerumque 1—3, rarius plura aggregata. Sporangia unilocularia ovata. Chromatophora disciformia numerosa in cellulis præsentia.

The plant is fixed to the substratum by means of short

Fig. 5. *Ectocarpus coniferus* nov. spec.
Part of a plant with plurilocular sporangia. (About 60 : 1).

rhizoids growing out from the lowermost cells in the filaments (Fig. 6 *e*).

The main filaments are about 40 μ thick consisting of cells from nearly 1/2 to 3—4 times longer than broad. The lengthening of the main filaments is mostly restricted to limited intercalary growing-points which occur near the insertion of a branch (Fig. 6 *a*) but now and then, also, a single cell here and there in the filaments may start to divide. All the filaments and lateral branches

are terminated with long hairs consisting at the end of long and nearly colourless cells and having a growing-point at their base.

The ramification is very irregular being sometimes nearly secund, sometimes alternating, just as the distance between the

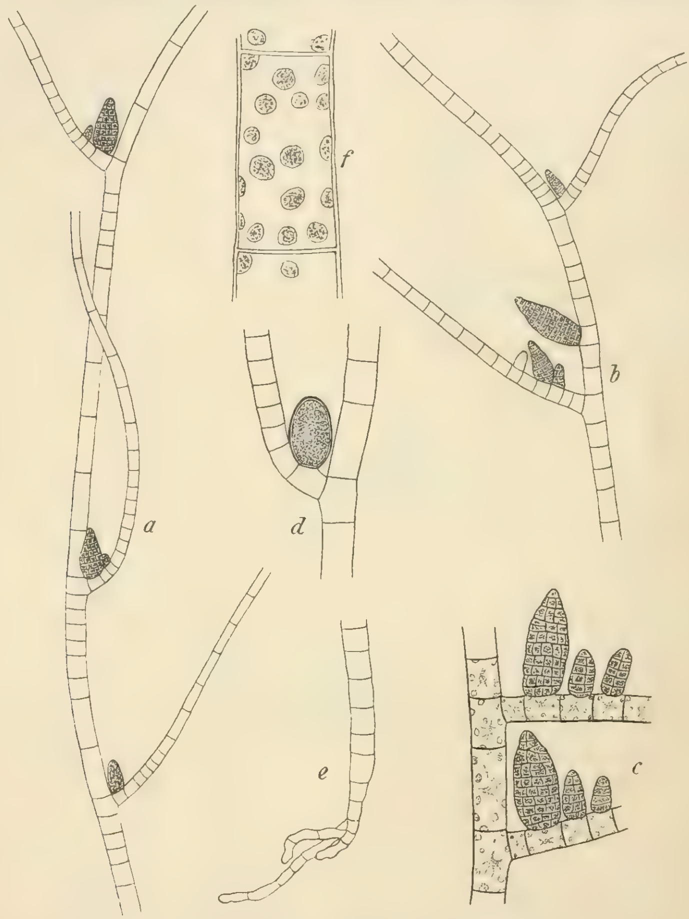


Fig. 6. *Ectocarpus coniferus* nov. spec.
*a*, part of thallus with a few plurilocular sporangia in each angle of branch. *b*, part of thallus with a plurilocular sporangium upon the main branch. *c*, plurilocular sporangia. *d*, unilocular sporangium. *e*, base of a filament. *f*, cell with chromatophores.
(*a*, *b*, *e*, about 50 : 1; *b*, *c*, *d*, about 90 : 1; *f*, about 250 : 1).

insertions of the branches is much variable. Some of the branches, especially in the lowermost part of the thallus, grow out to filaments like the main filaments; the others, especially the uppermost, are not branched or have only a single or few ramuli.

The branches are inserted in a right or somewhat acute angle to the main filaments (Fig. 5) and they are most often curved upwards (Fig. 6 *a*).

Upon their upper side in the angle between the branch and the mother-cell the sporangia are found.

The plurilocular sporangia are oblong-ovoid to conical and always sessile. Most often only a few, 1—3, sporangia occur in each angle, the largest of these, as a rule, being nearest to the main filaments (Fig. 6 *a*); but now and then a greater number develop; though a case with as many sporangia as is found in the fig. 5 (lowermost branch) is rare. More rarely plurilocular sporangia also were met with upon the main filaments (Fig. 6 *b*).

The plurilocular sporangia are of rather variable size, the smaller ones about 40 $\mu$ long and 24 $\mu$ broad while the larger may reach a length of up to 110 $\mu$ and a breadth of about 40 $\mu$.

The few unilocular sporangia found occur at the same place as the plurilocular sporangia, namely in the axis between the main filament and the branch (Fig. 6 *d*); they were nearly ovoid in shape and always solitary.

The chromatophores consist of small roundish discs, fairly numerous in each cell (Fig. 6 *f*).

It cannot be denied that this plant shows some likeness to *Ectocarpus Hincksiæ* Harv. but on the other hand it differs so much in several respects from Harvey's species that it cannot be considered a form of this species.

Thus the ramification is much more irregular than in *Ectocarpus Hincksiæ* with its usually regularly arranged, short, secund, pectinated, ramuli.

Furthermore the ramuli in the West Indian plant have marked intercalary growth-points near their base and invariably terminate with long, nearly colourless hairs, while in *E. Hincksiæ* the cells of the ramuli are divided nearly everywhere [1]) and are short and all nearly the same size. Sauvageau however (l. c.) mentions that occasionally some specimens are provided with short hairs. In specimens from the Færöes I have found no hairs.

The plurilocular sporangia occur usually solitary or a few (2—4) together in the axils of the ramuli in contradistinction to the usually numerous seriated sporangia of *Ect. Hincksiæ*.

And the elongated conical shape of the sporangia in the

[1]) Sauvageau, C., Observations relatives a la sexualité des Phéosporées, Journal de Botanique, 1897, p. 66.

present species is also different from the shorter, conical-piriform ones of *Ect. Hincksiæ*. The size of the plurilocular sporangia is more variable in *E. coniferus* and the larger ones exceed in size those in *Ectoc. Hincksiæ*.

The unilocular sporangia have only been found solitary in the axils of the branches while in *E. Hincksiæ* many occur together in a row along the upper side of the branch, and the involucre often found here (compare SAUVAGEAU l. c., and my remarks in The Marine Algæ of the Færöes, Botany of the Færöes, Part II, 1902, p. 412) has never been found in the West Indian plant.

In "Alg. Novara", p. 45 GRUNOW described a var. *australis* of *Ect. Hincksiæ* in which the ends of the ramuli sometimes ended in long hairs showing in this respect a likeness to the present plant.

After the above was written I received from Professor KUCKUCK (to whom I had sent a preparation of my plant) some drawings of his of *Ectocarpus irregularis* Kütz. and having seen these I saw at once that my plant was very nearly related to this species of KÜTZING being perhaps merely a form of it. Nevertheless some differences are present and as it comes from quite another geographical region to KÜTZING's plant (which is found in the Adriatic Sea) I think it justifiable to keep it as a full species. Judging from the very beautiful and instructive figures which Professor KUCKUCK most kindly allowed me to see, and further from the rather incomplete description found in the literature, the Adriatic plant seems to be somewhat smaller in all respects to the West Indian. This also Prof. KUCKUCK pointed out in his letter to me.

Further in the West Indian plant the plurilocular sporangia are found upon the upper side of the branches and nearly always in the corner between these and the main filaments only rarely do they occur upon the main filaments.

In the Adriatic alga, judging from the drawings of Prof. KUCKUCK, the sporangia seem to occur much more irregularly, very often upon the main filaments, sometimes even quite below the branches and also not so strictly confined to the upper side as in my plant, which just in this respect shows likeness with *Ectocarpus Hincksiæ*.

I may further add that when determining my plant I tried to refer it to *Ectocarpus irregularis* but the very misleading figure of KÜTZING ("Tab. Phycolog.", vol. 5, fig. 62) led me to give up the idea.

This species was found in the littoral and upper sublittoral region, growing epiphytic upon other algæ or on stones etc. It has been collected in much exposed as well as in more sheltered localities.

St. Croix: Christiansteds Harbour, Northside. St. Jan: Cruz Bay.

### 4. **Ectocarpus Rallsiæ** Vickers.

Vickers, A., Liste des Algues marines de la Barbade (Ann. Sc. Nat., Botanique, 9ième Série, vol. 1, 1905, p. 59); Phycologia Barbadensis, Part II, pl. 32.

Amongst *Ect. Mitchellæ* I found a small *Ectocarpus* which seems to agree with the figure of *E. Rallsiæ*, given by Mlle Vickers, l. c. As Mlle Vickers' description is rather poor I give here a further description from my plant.

The basal part consists of creeping, irregularly bent filaments (Fig. 7 *d*) twisted together. Underneath the filaments are fastened to the substratum by means of short rhizoids.

From their upper side the erect filaments spring up. These are composed of cells from nearly as long as broad, to about 5 times the length of their own diameter. Long and short cells are found intermingled owing to the fact that intercalary division may take place everywhere in the filaments (Fig. 7 *b*); in their upper end the filaments terminate in very long, colourless hairs. The diameter of the filaments reaches a length of about 27 $\mu$.

The ramification is not very great and rather irregular. Sometimes several branches are crowded together, sometimes the filaments for a long while remain unbranched. Some of the branches are short, others long and terminating in a long hairs.

Several small discoid chromatophores are found in each cell.

The plurilocular sporangia are fusiform with attenuated apex, sessile or often pedicellate. They are rather variable in size, the length varying from 80 $\mu$—120 $\mu$ or more and their diameter from 27 $\mu$—40 $\mu$.

The unilocular sporangia (Fig. 7 *b*) are oval-ovate, reaching a length of about 70 $\mu$ and a breadth of about 45 $\mu$.

Far up in a long hair in the end of a filament (Fig. 7 *d*) I noticed a series of short cells with chromatophores etc.; these cells were certainly actively dividing, also producing a branch from one of the cells. If this phenomenon is a common event I think it may be of some importance, as a method of propagation, to a plant living as it does intermingled between larger algæ.

*Ectocarpus Rallsiæ* is evidently nearly related to *Ectocarpus coniferus* and *Ectocarpus irregularis*. The most essential differences are as follows: the frequently stalked sporangia, the shape of the plurilocular sporangia, this being more cylindrical, tapering rather suddenly towards the apex (comp. M^lle^ VICKERS' fig. l. c.), and also the distribution of the sporangia, these being placed anywhere upon the filaments, much more irregularly than in *Ectocarpus coniferus*. Furthermore the filaments in *Ectocarpus Rallsiæ* are nearly all fairly uniform, reaching a diameter of about 27 $\mu$.

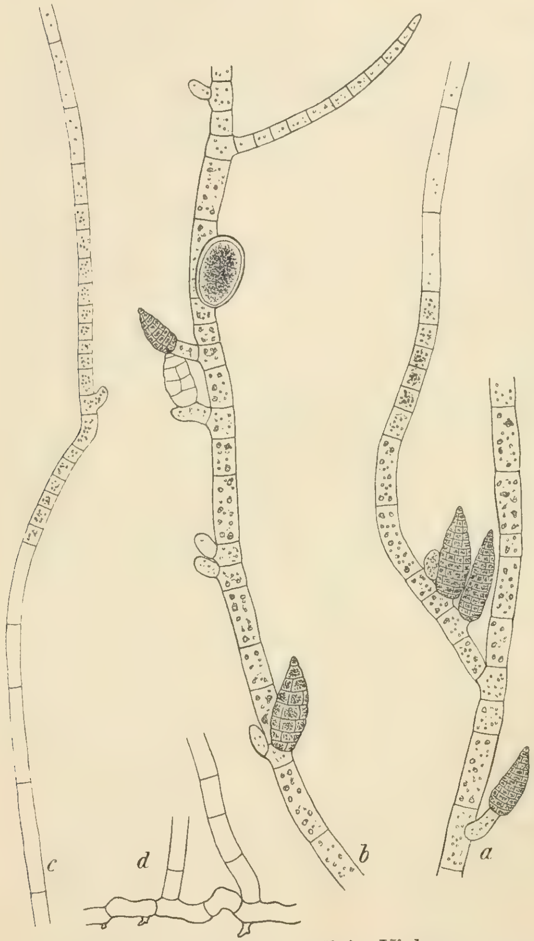


Fig. 7. *Ectocarpus Rallsiæ* Vickers.
*a*, part of thallus with plurilocular sporangia. *b*, filament with plurilocular and unilocular sporangia. *c*, cells in active state in the upper end of a hair. *d*, base of a plant.
(*a* and *b*, about 90 : 1; *c* and *d*, about 70 : 1).

This species was only found once, St. Thomas: Store Nordside Bugt.

Geogr. Distrib. West Indies.

### 5. Ectocarpus rhodochortonoides nov. spec.

Ectocarpus filamentis erectis e filis repentibus, horizontalibus, irregulariter flexuosis, egredientibus instructus.

Filamenta erecta, parce ramosa, 21 $\mu$ crassa, superne in pilum transformata. Articuli in inferiori parte filorum usque ad 3 plo longiores quam latiores, in pilis usque ad 14 plo.

Sporangia plurilocularia sessilia, interdum breve pedicellata,

ovalia—rectangularia, 33 $\mu$ long. et 22 $\mu$ lat., interdum elongata clavataque usque ad 64 $\mu$ long., 27 $\mu$ lat.

Growing upon an old *Padina* together with some other *Ectocarpi* were found a few specimens of a small *Ectocarpus*.

The plant had creeping, irregularly bent, basal filaments from which the erect filaments grow up (Fig. 9 *f*). The cells in the basal, rhizoidal filaments have rather thick walls and are about three times as long as broad, the diameter being about 8—9 $\mu$.

The erect filaments have cylindrical cells, which in the lower part of the filaments are 2—3 times as long as their own diameter, which is about 11 $\mu$. Higher up the cells can reach a length of up to 150 $\mu$ or nearly 14 times their own breadth. The long cells in the end of the filaments make these hairlike, and are devoid or almost devoid of chromatophores etc. (Fig. 8). The growth of the filaments takes place by division of the cells in the middle and lower part of the filament. A marked growing zone is found at times, but not always.

The chromatophore is ribbonlike and irregularly ramified (Fig. 9 *b*).

From the cells in the middle and lower part of the filaments thin rhizoids are occasionally found growing downwards (Fig. 9 *a*).

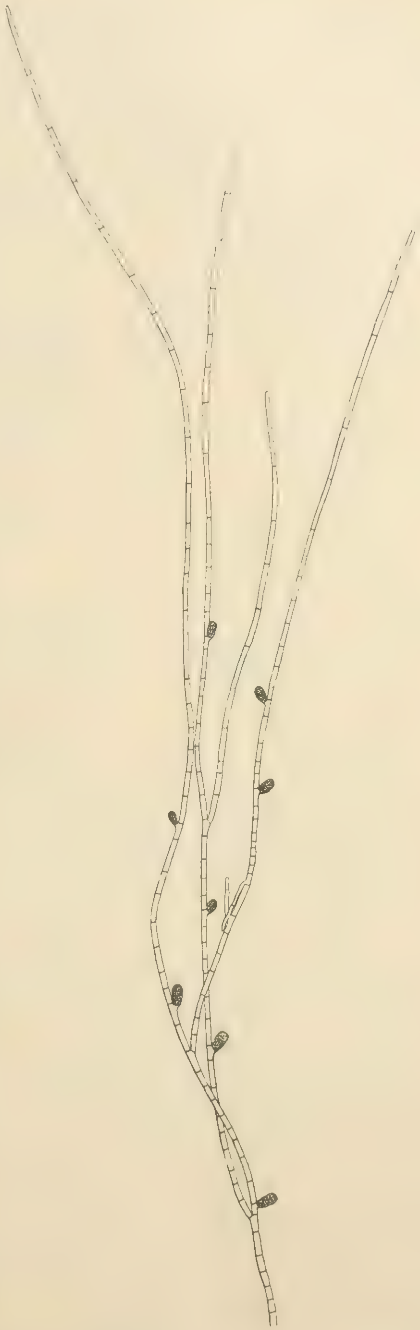

Fig. 8. *Ectocarpus rhodochortonoides* nov. spec. Part of a plant. (About 40 : 1).

Only plurilocular sporangia were met with; their shape was rather characteristic being oval-rectangular with roundish angles (Fig. 9 *a* and *b*); a few longer, clavate sporangia with undulated walls were also found (Fig. 9 *c*, *d*). The loculi are large, about 8 $\mu$ high and 10 $\mu$ broad.

The oval sporangia were about 22 $\mu$ broad and 33 $\mu$ long; the longer, clavate ones up to 64 $\mu$ long and 27 $\mu$ broad.

The sporangia are mostly sessile, rarely borne on a short stalk (Fig. 9 *e*).

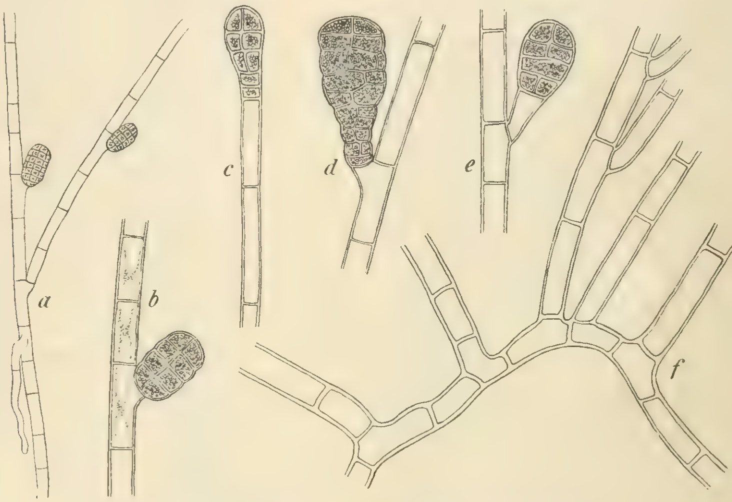


Fig. 9. *Ectocarpus rhodochortonoides* nov. spec.
*a*, part of a plant with plurilocular sporangia and a rhizoid. *b*, a plurilocular sporangium and cells with chromatophores. *c*, a terminal plurilocular sporangium. *d*, a clavate plurilocular sporangium. *e*, a stalked plurilocular sporangium. *f*, base of a plant. (*a*, about 90 : 1; *b*–*f*, about 200 : 1).

In the shape of the plurilocular sporangia with their large loculi our plant strongly reminds one of *Ectocarpus breviarticulatus* but in this species the sporangia are placed at right angles to the filaments while these are here curved upwards. In addition to this there is much difference in the vegetative parts of the plants.

This species shows also some likeness to *Ectocarpus variabilis* of M^lle^ Vickers (Phycologia Barbadensis, Part II, pl. 31); but this form differs from mine in its much shorter cells which seem to be of the same length in the whole plant. Further the shape of the plurilocular sporangia is also different.

The few specimens found were collected in exposed places in the littoral region.

St. Croix: Northside, Cane Bay.

### 6. **Ectocarpus breviarticulatus** J. Ag.

J. Agardh, Nya alger från Mexico (Öfversigt af K. Vetensk.-Akad. Förhandl. 15. Jan., 1847, p. 7).

*Ectocarpus hamatus* Cr. in Mazé et Schramm, Essai de classification des Algues de la Guadeloupe, 2e Edit. 1870—1877, p. 111.

Vickers, A., Phycologia Barbadensis, part II, pl. 29.

By means of original specimens collected by Liebmann near St. Augustin in Mexico and determined by J. Agardh I have been able to see that *Ectocarpus hamatus* of Crouan, so well figured in the "Phycologia" of Mlle Vickers belongs to this species. As the description of J. Agardh is rather deficient and Mlle Vickers in her "Liste" does not give any description of it I here mention it in a little more detail.

The plant forms rather large tufts, 2—4 cm high or even more, and these tufts are again composed of thinner and thicker rope-like spongy masses. By means of the numerous hooks and short bent ramuli, spread along the main filaments the whole becomes twisted together just as in *Ectocarpus tomentosus*. The growth takes place at any point in the filaments. These are about 27 $\mu$ thick. The length of the cells is usually 1—2 times their own diameter, rarely a little shorter or longer.

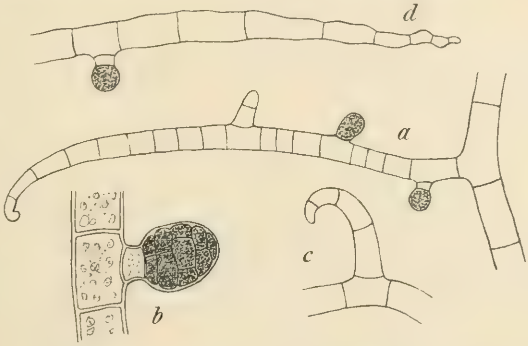


Fig. 10. *Ectocarpus breviarticulatus* J. Ag. *a*, a branch with young plurilocular sporangia. *b*, cells with chromatophores and a ripe plurilocular sporangium. *c*, a hookformed ramulus. *d*, a branch with rhizoid-like apex. (*a*, *c* and *d*, about 90 : 1; *b*, about 190 : 1).

The plurilocular sporangia are nearly spherical in shape or somewhat ovoid (Fig. 10 *b*). They are placed nearly at right angles upon the filaments and have a very short stalk consisting only of a single small cell. The length of the sporangia is about 62 $\mu$; the breadth about 57 $\mu$.

Unilocular sporangia were not found.

Instead of hooks the ramuli sometimes run out into thin rhizoids (Fig. 10 *d*).

Several small roundish or more irregular discoid chromatophores are present in each cell (Fig. 10 *b*).

This species belongs to the littoral and the upper sublittoral region.

It occurs upon rocks and stones and is found even in the most exposed places where the waves constantly splash the rocks.

St. Croix: Cane Bay, Northside; St. Thomas: Store Nordside Bugt, near the entrance of the harbour.

Geogr. Distrib. Mexico, West Indies.

### 7. **Ectocarpus elachistæformis** Heydr.

Heydrich, F., Beitäge zur Kenntnis der Algenflora von Kaiser-Wilhelms-Land (Deutsch Neu Guinea). Berichte der deutsch. bot. Ges., Bd. X, 1892, p. 470, pl. XXV, fig. 14.

In the cryptostomata of an old *Sargassum vulgare* which was quite overgrown by various algæ, e. g. *Chantransia*, *Erythrotrichia*, *Rivularia* etc. was found a small *Ectocarpus* which filled up nearly the entire cavity.

This plant I think can be referred to *Ectocarpus elachistæformis* Heydr. even if it shows some differences.

It reached a height of about 1—3 mm and had horizontal, irregularly bent, basal filaments growing more or less together forming in this way a small irregular disc (Fig. 11 *a*). From this, short rhizoids, consisting only of a few cells, penetrate downwards into the tissue of the host plant (Fig. 11 *b*, *c*); and upwards long assimilating filaments and plurilocular sporangia are produced.

The assimilating filaments are thickest at their base, here about 10—14 $\mu$ broad, upwards thinner, about 8 $\mu$; they consist of cylindrical cells which below are only a little longer than broad, the growing point being here; higher up the cells grow longer reaching a length of up to 5 times their own width. The assimilating filaments are simple throughout with the exception of a few quite short branches near their base upon which terminal plurilocular sporangia are placed.

These short branches consist most often of only a single cell sometimes of a few. Such short branches with plurilocular sporangia are also found growing immediately out from the cells in the basal filaments.

Now and then also sessile sporangia placed immediately upon the filaments occur.

The plurilocular sporangia are elongated lanceolate, broadest a little below their middle. They are about 100—140 $\mu$ long and 16—23 $\mu$ broad. The zoospores escape by means of a hole in their top (Fig. 11 *b*).

The chromatophores have the form of irregularly bent filaments.

This species seems to come quite near if it is not indeed identical with the form described and figured by M[me] Weber in "Liste des Algues du Siboga", I, p. 128 and here designated *Ectocarpus elachistæformis* Heydr. prox. The way of growing, the shape and size of the sporangia, the breadth of the assimilating filaments all seem exactly the same.


Fig. 11. *Ectocarpus elachistæformis* Heydr.
Parts of thallus with plurilocular sporangia.
(*a*, *b*, about 200 : 1; *c*, 150 : 1).

The only differences I have found were that the length of cells in the upper part of the assimilating filaments attain a greater length than in my plant (more than double), and that "le sommet de ces derniers [filaments longs] se transforme en longues cellules hyalines: le pseudo poil", while those in my plant all contain chromatophores. The shape of the chromatophore is not mentioned by M[me] Weber.

Judging from the description and figure of Heydrich his plant shows the following differences.

The erect filaments are here more branched, thicker, with shorter cells and bear the sporangia on short side-branches somewhat over their base (comp. HEYDRICH's figure, pl. XXV, fig. 14), now and then sporangia are also found higher up upon the filaments. The sporangia are somewhat thinner (15—20 $\mu$) and judging from the figure of HEYDRICH they also seem to be shorter.

St. Thomas: French Wharf.

Geogr. Distrib. New Guinea, Gulf of Aden.

## *Fam. 2. **Encoeliaceæ.***

### **Colpomenia** Derb. et Sol.

#### 1. **Colpomenia sinuosa** (Roth) Derb. et Sol.

DERBÈS, A., and A. J. J. SOLIER, Mémoire sur quelques points de la Physiologie des Algues, p. 11 (here called *sinuata* but in the description of the figures (p. 119) and at the plate 22 we find *sinuosa*).

*Ulva sinuosa* Roth, Catalecta Botanica, III, p. 327, tab. XII, fig. a.

*Asperococcus sinuosus* Bory, Expedition scientifique du Morée, t. III, p. 326 (non vidi). Nouvelle Flore du Péloponnèse et des Cyclades, 1838, p. 76. J. AGARDH, Spec. Alg., I, p. 75.

*Encoelium sinuosum* Ag., Spec. Alg., I, p. 146; Systema p. 262. KÜTZING, Spec. Alg., p. 552; Tab. Phycol., vol. IX, pl. 8.

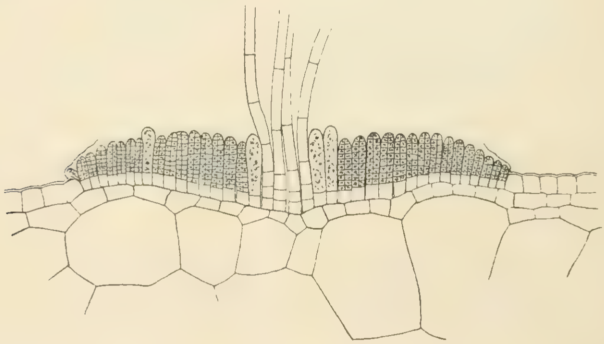

Fig. 12. *Colpomenia sinuosa* (Roth) Derb. et Sol.
Transverse section of the thallus showing plurilocular sporangia together with paraphyses surrounding a group of hairs. (About 90 : 1).

Fructifying specimens with ripe plurilocular sporangia were collected in the area of the sea with shallow water behind Long Reef at Christianssted. As described by MITCHELL in MURRAY „Phycological Memoirs", Part II, p. 53 the plurilocular sporangia occur in dense groups scattered over the whole surface of the thallus being formed round the depressed groups of hairs.

The sporangia are cylindrical or somewhat clavate and dispersed between them we find the club-shaped paraphyses sometimes rather numerous, sometimes very scarce or even wanting. According to MITCHELL the paraphyses originate from the basal cell of the sporangia and therefore are not formed until after the disappearance of the sporangia. As to this I must point out that I have found paraphyses scattered also between the plurilocular sporangia in the sori (see Fig. 12).

It is a common species and occur mostly in sheltered or not much exposed places in shallow water.

Geogr. Distrib. Widely distributed in all warmer seas so far north as to the south coast of England.

## Hydroclathrus Bory.

### 1. Hydroclathrus cancellatus Bory.

BORY, Dict. class. VIII, p. 419 (non vidi). HARVEY, Phycologia Australica, pl. 98; Nereis, p. 120, tab. IX A. MITCHELL, M., in MURRAY, Phyc. Memoirs, p. 53, pl. XV, fig. 2–4. THURET, G. et Ed. BORNET, Études phycologiques, 1878, p. 12—13. VICKERS, A., Phycologia Barbadensis, Part II, pl. 23.

*Asperococcus cancellatus* Endl., Mantissa Botanica altera, Suppl. 3, 1843, p. 26.

*Halodictyon cancellatum* Kütz., Phycologia generalis, 1843, p. 336.

*Encoelium clathratum* Ag., Spec. Alg. p. 412.

*Stilophora clathrata* Ag. in "Flora", 1827, p. 642.

*Asperococcus clathratus* J. Ag., Spec. Alg. I, p. 75.

In "Études Phycologiques", l. c., THURET and BORNET have pointed out that while the sporangia entirely cover the surface of the young plants the old specimens with the well known peculiar reticular appearance are quite sterile with the exception of some few sporangia occurring now and then near the groups of hairs. Having only collected old specimens mine, in accordance with this observation, were sterile; even near the hair groups I have not succeeded in finding sporangia.

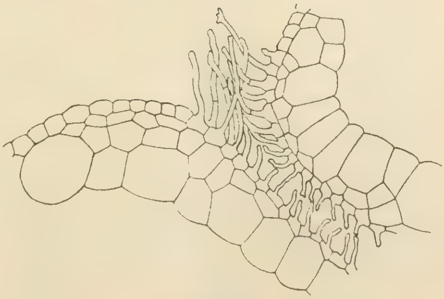

Fig. 13. *Hydroclathrus cancellatus* Bory. Transverse section of the thallus showing rhizoids growing out from the surface cells. (About 170 : 1).

As pointed out by

Mitchell, l. c., p. 56, the innerside of the strand in the netlike thallus is often ruptured in such a way that a large area of the cells in the interior of the thallus are exposed. The edges of these fissures have an inclination to curl inwards. If it happens that the edges come near each other the small surface cells grow out into shorter or longer rhizoid-like prolongations and in this way the fissure may be closed (comp. Fig. 13).

This species is common on the shores of the Islands. It occurs in the littoral and upper sublittoral region, in sheltered or not very much exposed localities.

Geogr. Distrib. Seems to occur in all warmer seas.

## Rosenvingea nov. gen.[1]).

Frons tubulosa, cylindracea, vel leviter compressa, disco radicali adfixa, ramosa, ramis sparsis vel pseudodichotomis. Incrementum intercalare divisione cellularum frondis totius adest. Frons ex 3—4 stratis cellularum composita, cellulis exterioribus minoribus ad cavitatem versus majoribus, cellulis peripheræ chromatophora disciformia singula continentibus. Pila aut singula aut plura aggregata, per totam frondem sparsa aut in soris aut in parte sterili præsentia.

Sori maculis valde irregularibus per totam superficiem frondis dispersi.

Sporangia plurilocularia subcylindracea aut clavata, e cellularum corticalium divisione orta.

### 1. **Rosenvingea Sanctæ Crucis** nov. spec.

Frons cylindracea aut leviter compressa, ca. 20 cm alta, superficie irregulariter rugosa, disco basali ex rhizoideis numerosissimis composito adfixa.

Rami sparsi, interdum pseudodichotomi, ad apicem et interdum ad basem attenuati. Pila aut singula, aut pauca aggregata per totam superficiem frondis aut sterili, aut sporiferi sparsis.

Lat. pilorum = 8—9 $\mu$.

Sporangia plurilocularia, subcylindracea aut clavata, in soris irregularibus per totam superficiem frondis distributa.

Long. spor. pluriloc. = 20—40 $\mu$.
Lat. — — = 5—12 $\mu$.

[1]) Named after my compatriot, the well known phycologist, Dr. L. Kolderup Rosenvinge.

Fronds tufted up to 20 cms high; mostly nearly cylindrical, sometimes somewhat compressed, the surface being more or less uneven. It is irregularly ramified (Fig. 14); the ramification is monopodial, but the lateral branches are often vigorously developed in this way being more or less pseudodichotomious and the apices of the branches in the same time getting an antler-like appearance (Fig. 15 *a*, *b*, *c*).

The thallus is hollow (Fig. 16) with the exception of the lowermost part where the interior of the tubular frond is filled with hyphal filaments growing downwards from the innermost cells (Fig. 15 *d*). These filaments together with numerous rhizoids growing out from the peripheral cells in the basal part of the frond form a small disc by means of which the plant is fastened to the substratum.

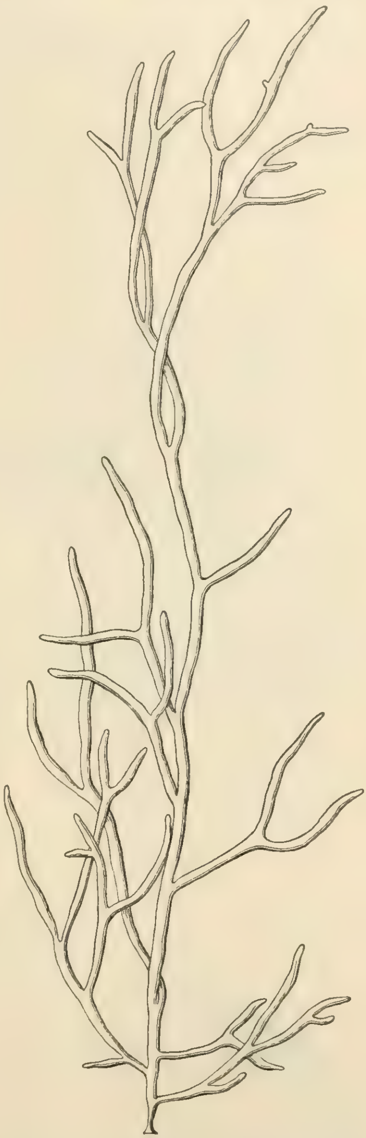
Fig. 14. *Rosenvingea Sanctæ Crucis* nov. spec. Habit of plant. (About natural size).

The growth takes place by intercalary division through the whole thallus; yet we may conclude that a vigorous division of cells also takes place in the ends of the branches though any true apical cell division is out of the question.

The diameter of the thallus reaches about 2 mm. The branches taper somewhat towards their apices and also sometimes towards their bases.

In a transverse section (Fig. 16) the thallus is seen to consist of 3—4 layers of cells; these are small, epidermal-like with rather thick walls at the surface, large, irregularly roundish-polygonal with thin walls against the hollow interior. Seen from above the surface cells are irregularly polygonal (Fig. 15 *f*); the cells in the interior,

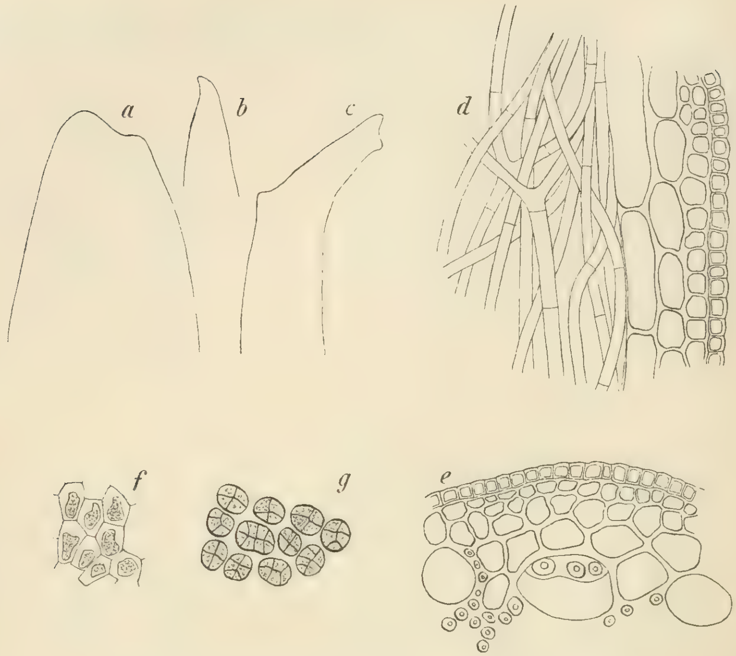


Fig. 15. *Rosenvingea Sanctæ Crucis* nov. spec.
*a*, *b*, *c*, the antler-like apices of the plant. *d*, longitudinal section through the basal part of the plant showing the hyphal filaments in the interior. *e*, transverse section of the basal part. *f*, surface cells with chromatophores. *g*, plurilocular sporangia seen from above.
(*a*, *b*, *c*, about 15 : 1; *d*, *e*, about 150 : 1; *f*, *g*, about 200 : 1).

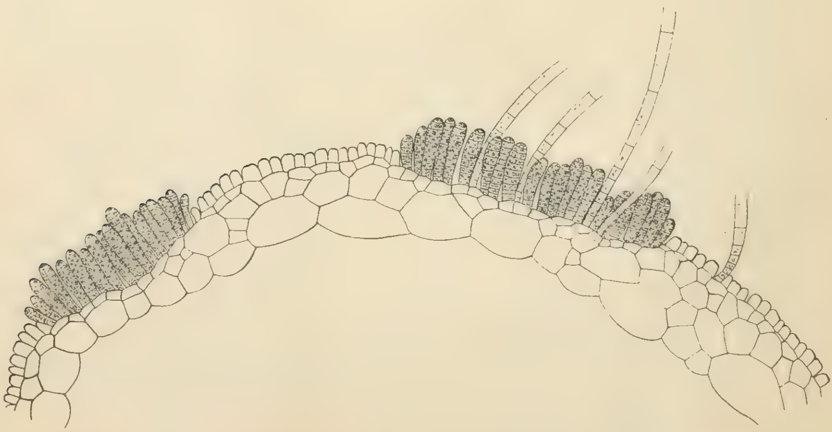

Fig. 16. *Rosenvingea Sanctæ Crucis* nov. spec.
Transverse section of the thallus with sori of plurilocular sporangia and hairs. (About 150 : 1).

especially the innermost, are lengthened, often nearly cylindrical. Here occur also now and then a few hyphal filaments running along the walls of the large cells.

The surface cells each contain a small, irregularly lobed, flat chromatophore (Fig. 15 *f*). The large cells in the interior seem to be nearly or quite colourless.

Hairs, isolated or a few together, occur scattered over the whole surface of the thallus (Fig. 16). They are found in the sterile as also in the fertile part of the thallus but most commonly in the latter, where they are present sometimes in the middle sometimes in the periphery of the sori and most often isolated though occasionally two-three together.

The diameter of the hairs is about 8—9 $\mu$.

The plurilocular sporangia occur in irregularly formed groups spread over the whole surface of the frond (Fig. 17). The sporangia are developed from the surface cells. They are cylindrical, or often somewhat clavate (Fig. 16) and reach a length of 20 $\mu$—40 $\mu$ and even more and a breadth of 5—12 $\mu$. Paraphyses are wanting. At the edges of the sori the sporangia become gradually shorter and pass evenly into the sterile surface cells. A small depression is sometimes found in the middle of the sori but not always.

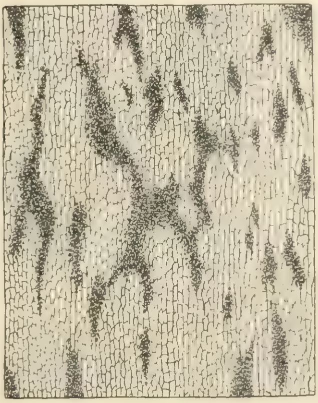

Fig. 17. *Rosenvingea Sanctæ Crucis* nov. spec. Surface view of a plant showing the irregular groups of plurilocular sporangia. (About 20 : 1).

I had no sooner started to examine this plant than I began to realize that I was probably dealing with a new genus. The plant appeared related to the family *Encoeliaceæ* and especially to the group *Scytosiphoneæ*, comp. Kjellman in "Die natürl. Pflanzenfam.", 1. Theil, 2. Abt., p. 197. Certain difficulties arise in referring this plant to this group e. g. its ramification. I therefore asked the opinion of Professor Kuckuck and he most kindly gave me very useful information.

Professor Kuckuck agreed with me that my plant was a representative of a new genus and that it was nearly related to *Scytosiphon*. He directed my attention to some species till now usually referred to *Asperococcus* and to *Chnoospora fastigiata* and most kindly sent me drawings as well as preparations of these for comparison.

As to the last mentioned plant this was already known to me from the description of *Chn. fastigiata* by Mrs. GEPP[1]). And further I have been able to examine *Chn. implexa* by the kindness of M^me^ WEBER. Even if these species are nearly related to *Rosenvingea*, it is to be remarked on the other hand that as I shall mention later on in more detail, they, especially *Chn. fastigiata*, differ so much from it, that they can not be referred to a common genus.

With the above mentioned *Asperococcus* species the case is quite different. The species in question are: *Asperococcus orientalis* J. Ag., *Asperococcus intricatus* J. Ag. and *Asperococcus fastigiatus* Zanard. Here the correspondence is so great that there can be no doubt that they must be very closely related to my plant and therefore I have not hesitated to refer these species to *Rosenvingea*.

Nearest related to my plant seems to be *Rosenvingea orientalis*. It was originally described by J. AGARDH in "Spec. Gen. et Ord. Alg.", vol. I, 1848, p. 78 and has later on been referred to *Encoelium* by KÜTZING („Spec.", p. 551) and to *Hydroclathrus* by HEYDRICH in "Hedwigia", vol. 33, 1894.

From Professor KUCKUCK I obtained for comparison with my plant drawings and preparations. Judging from these *Rosenvingea orientalis* differs essentially by the absence of hairs, further the sporangia and the cells on the whole seem to be somewhat smaller. As I wished very much also to see the habit of the plant I asked M^me^ WEBER to allow me to see her specimens from the Indian Ocean and she most kindly sent me all her dried material of this species to examine. These differ from my plant in their more slender thallus, especially the ends of the branches which are nearly hairlike; on the other hand the plant has more than the double height of the mine and it is more richly branched.

Of *Rosenvingea intricata* I have had a collection of dried original specimens from Vera Cruz, collected by LIEBMANN and determined by J. AGARDH, further a dried specimen collected at Barbadoes by M^lle^ VICKERS and material in spirit collected during the "Siboga"-Expedition, which M^me^ WEBER-VAN BOSSE has most kindly lent to me.

It is described by J. AGARDH in "Alg. Liebm.", p. 7 and in "Species Alg.", I, p. 77. KÜTZING in "Species Alg.", p. 551 calls it *Encoelium intricatum* and gives a good figure of it in "Tab.

[1]) E. S. BARTON, On the Fruit of Chnoospora fastigiata, J. Ag. in Journal of the Linnean Society, vol. XXXIII, 1898, p. 507.

Phycologicæ", vol. IX, pl. 5. HEYDRICH, l. c. refers it to *Hydroclathrus*.

*Rosenvingea intricata* is a much and very irregularly branched species; M^lle VICKERS figure is a good one.

So far I have been able to see hairs occur in groups several together both in the sterile part of the thallus and in the sori. In M^lle VICKERS' specimen the sori are roundish and sharply defined. This agrees with HEYDRICH's statement that: "*H. intricatus* hat ziemlich scharf begrenzte Sori mit dicht gedrängt stehenden langen Gametangien, welche 12—15 meist doppelte Gameten enthalten". The specimens of LIEBMANN I have examined were sterile. So far as I have been able to see the cells contain a single chromatophore.

The third species, *Rosenvingea fastigiata* (Zanard.), is described by ZANARDINI in „Phycearum Indicarum Pugillus", p. 134, tab. 3, fig. 1—3 [1]) and where we have also a good figure of the plant; of the f. *major* Reinb. (in SCHMIDT, Flora of Koh Chang, Part IV, Bot. Tidsskrift, vol. 31, 1901) I have been able to examine original specimens and finally Prof. KUCKUCK has most kindly sent me a preparation and a drawing of its sori.

A well marked character is the group of hairs in the middle of the roundish sori. A small disc-shaped chromatophore is present in each of the epidermal cells. The habit of this plant is very different from mine.

As mentioned above *Rosenvingea* is nearly related to *Chnoospora* in several ways. This genus has e. g. the same apex and ramification but it differs essentially in its solid somewhat compressed thallus [2]).

[1]) In Memorie del Reale Instituto Veneto, vol. 17, Venezia 1872.

[2]) M^me WEBER-VAN BOSSE has had the great kindness to allow me to examine a collection of *Chnoospora implexa* from the "Siboga"-Expedition. As this species seems to differ considerably from *Chn. fastigiata* I give a short description. The solid thallus is somewhat compressed and consists of larger cells in the middle, and small cells with chromatophores at the periphery. Groups of plurilocular sporangia were found scattered over the surface of the thallus. In these I found no hairs; the latter occurred scattered in the sterile part of the thallus, but not in great numbers. The plurilocular sporangia differ somewhat from these I found in *Rosenvingea*; they are more clavate and in the uppermost end divided into several rows of small cells. Above each sporangium we find the membrane of the mother cell. In each cell was an irregularly lobed chromatophore, and sometimes two occurred. From *Chnoosp. fastigiata* as we know this plant from Mrs. GEPP's description l. c. p. 507, this species differs in its marked

From *Scytosiphon Rosenvingea* differs especially in its ramification and the want of paraphyses.

With regard to the anatomical structure and as to the arrangement and shape of the sporangia *Rosenvingea* comes also near to *Hydroclathrus* and *Colpomenia*.

## *Fam. 3.* ***Mesogloiaceæ.***

### **Castagnea** Derb. et Sol.

#### 1. **Castagnea Zosteræ** (Mohr) Thur.

THURET in Le Jolis, Liste des Algues marines du Cherbourg, 1863, p. 85.
FARLOW, W. G., The Marine Algæ of New England, 1881, p. 86, pl. 7, fig. 2.
BORNET, E., Les Algues de P. K. A. Schousboe, 1892, p. 236.

*Rivularia Zosteræ* Mohr, Bemerkungen über die Rothischen Rivularien in WEBER, Beiträge zur Naturkunde, vol. 2, 1810, p. 367.

A great confusion as to the definition of species and also of genera prevails in the group of *Mesogloiaceæ*, and several of the species of earlier authors are sometimes referred to one form. sometimes to another. When comparing my plant with earlier described forms it seemed to me that judging from their figure it showed no little likeness to *Castagnea polycarpa* Derb. et Sol. But great similarity with FARLOW's figure of *Castagnea Zosteræ* was also obvious. On the other hand the method of growing in my plant seemed to differ essentially from the description of SCHMITZ (as to which more later) and having only very little authentic material (and that only dried) to compare with I asked Prof. KUCKUCK as to his opionion of my plant.

Prof. KUCKUCK has now most kindly communicated to me that it seems to him that my plant comes near to *Castagnea Zosteræ*, but he added that he had not yet arrived to any definite conclusion as to the generic and specific arrangement in the group of *Mesogloieæ*.

In the following I now give a description of my plant so detailed that I hope it may be possible to recognize it when Prof. KUCKUCK's work: "Die Phæosporeen" has appeared.

The specimens found were growing in tufts, 15—20 cms and more high, epiphytic upon the leaves of *Thalassia testudinum*. They were fixed to the leaves of the host plant by means of a small disc.

The central main filaments are connected rather firmly together to form an axial fistulous layer, leaving a cavity open

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cryptostomata with numerous hairs around which the nearly cylindrical plurilocular sporangia occur.

in the middle. The union of the filaments is due to a tough mucilage which holds them together. But after boiling the plant for a short time in water the filaments easily separate in such a way that their mode of growth was observable.

As the figures (Fig. 18 *a*, *b*, *c*) show the central filaments increase by means of intercalary growth. Each filament termi-


Fig. 18. *Castagnea Zosteræ* (Mohr) Thur.
Summits of filaments showing way of growing.
(*a*, *c*, about 150 : 1; *b*, about 200 : 1).

nates with a long hair, the cells of which are long and colourless at the upper end being shorter and shorter towards its base. Here we have the growing point from below which the cells of the main filaments are formed, and above those of the hairs. At their base the hairs have a thin sheath.

When this method of growth has continued for a time the end of the filament is bent out laterally and a side branch similar

to the mother filament grows out as a prolongation; after some time this again is bent outwards and a new branch continues the

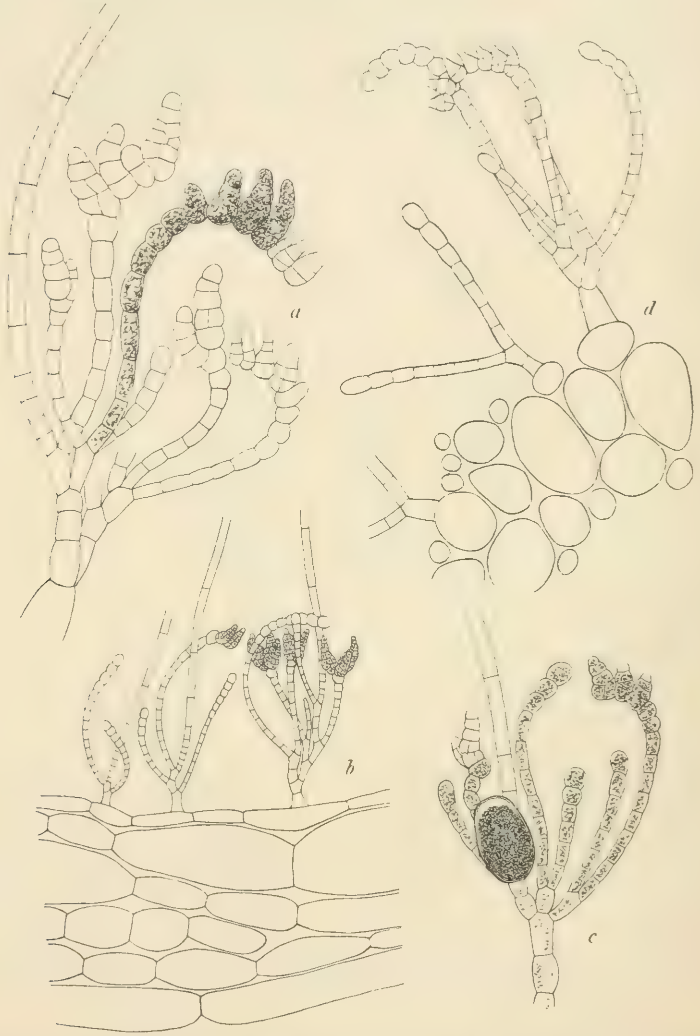


Fig. 19. *Castagnea Zosteræ* (Mohr) Thur.
*a*, summit of assimilation-filaments transformed to plurilocular sporangia; *b*, longitudinal section of the thallus; *c*, unilocular sporangium; *d*, transverse section of the thallus. (*a*, *c*, *d*, about 200 : 1; *b*, about 90 : 1).

growth and so forth. The growth of the filaments is in this way sympodial (Fig. 18 *a*). Now and then it happens that the lengthening of the filaments also takes place monopodially for some time as the figure shows (Fig. 18 *b*).

Occasionally from the basal cell in the sympodium rhizoid-like filaments grow downwards between the larger barrel-shaped cells of the main filaments (Fig. 18 *a*).

Below the growing point the cells in the filaments remain short, further down they grow longer, nearly barrel-shaped, reaching a length of up to 200 $\mu$ or even more and a breadth of up to 80 $\mu$. The cells are nearly colourless and as mentioned above firmly connected; upon a transverse section (Fig. 19 *d*) we find this central tube to be composed of several layers of cells.

This central tube is entirely surrounded with the dense layer of assimilating filaments. From the outer side of nearly all the cells in the peripheral filaments short branches grow out (Fig. 19 *b*, *d*). Their basal undivided part mostly consists of a single cell or rarely of two or three, these cells bear the assimilating filaments sometimes also a hair.

The assimilating filaments consist of a series of cells, the lowermost nearly cylindric and thin, those higher up thicker and moniliform; they have all, especially the uppermost cells, well-developed chromatophores. The diameter of the basal cylindrical cells reaches a length of about 8 $\mu$, that of the upper moniliform cells of about 13 $\mu$.

The diameter of the hairs is about 11 $\mu$ long and the uppermost cells in these reach a length of up to 12 times the diameter.

The plurilocular sporangia are formed by outgrowths from the uppermost cells of the assimilating filaments (Fig. 19 a). These cells, often several together, grow out to conical, or sometimes quite irregular, or even branched bodies which are divided by means of transverse and longitudinal walls. The gametes escape through an opening in the upper end of the sporangia (Fig. 19 *a*, *d*).

A few unilocular sporangia were found together with the plurilocular sporangia in the same plant (Fig. 19 *c*); these are placed at the base of the assimilating-filaments. They are oval-ovate of shape, about 40 $\mu$ long and 60 $\mu$ broad.

The description of the method of growth of *Castagnea* (*Eudesme*) *virescens* given by Reinke[1]) and especially by Schmitz[2]) differs, it cannot be denied, most essentially from that I have found in my plant. Besides *Castagnea*, Schmitz also examined a *Myriocladia* sp. and as to them he writes as follows: "Dabei fand ich nun, übereinstimmend bei den beiden genannten Arten, dass in

[1]) Reinke, J., Algenflora der westlichen Ostsee, p. 76.

[2]) Schmitz, Fr., Kleinere Beiträge zur Kenntniss der Florideen, V. (Nuova Notarisia, vol. 5, 1894, p. 707).

jedem fortwachsenden Spross ein centraler Leitfaden, eine ächte Centralachse, das Spitzenwachsthum vermittelt. Diese monopodial fortsprossende Centralachse bildet nach allen Seiten aus ihren Gliederzellen Zweiglein, die theils langsamer, theils rascher heranwachsen". This short quotation shows clearly the differences that exist as in my plant I have always found several filaments in the growing point, and these filaments had a sympodial growth.

On the other hand the growth of my plant seems to agree well with that which M^me^ WEBER found in the plant referred by her to *Bactrophora nigrescens*[1]). M^me^ WEBER has given a very detailed description and beautiful figures of its method of growth. In response to my request M^me^ WEBER has also been so very kind as to allow me to examine her plant and having compared it with the mine I cannot deny that upon the whole it has much resemblance. The specimen I saw was sterile but M^me^ Weber has found unilocular sporangia. In this connection I wish also to draw attention to that which Prof. KUCKUCK has written in a review[2]) of M^me^ WEBER's paper: "Die Identifizierung einer Mesogloeacee als *Bactrophora nigrescens* erscheint dem Ref., der die HARVEY'sche Originalpflanze untersuchen konnte, sehr zweifelhaft. Das bei der malayischen Pflanze beobachtete sympodiale Wachstum kann er für andere Mesogloeaceen bestätigen".

My plant was only found once in a somewhat sheltered place in shallow water ; it was growing epiphytic upon the leaves of *Thalassia testudinum*.

St. Croix: At the estate Lt. Princess behind Long Reef.
Geogr. Distrib. Atlantic coast of Europe and North America.

## *Fam. 4.* ***Myrionemaceæ.***

### **Myrionema** Grev.

#### 1. **Myrionema** spec.

Upon an old *Padina* a small disc-shaped alga was found which showed much likeness to *Myrionema*, e. g. to forms of *Myrionema vulgare* as figured by SAUVAGEAU in his paper treating of the Myrionemaceæ.

The disc in this specimen increases by means of marginal growth ; seen from above it is found to be composed of horizontal filaments, radiating from the centre, being now and then dichotomously divided.

[1]) WEBER- VAN BOSSE, A., Liste des Algues du Siboga, I, 1913, p. 139.
[2]) In "Zeitschrift für Botanik, 6. Jahrg., 4. H., 1914, p. 361.

The size of the cells differs rather much, their length being about 20 μ and their breadth 10 μ more or less.

Near the periphery the disc consists of a single layer of cells, in the middle of several. From the surface long hairs and short assimilating filaments grow upwards. The hairs have a basal growth zone and long colourless cells at their top. They have a well-developed sheath at their base.

Their diameter is about 14 μ.

The assimilating filaments consist of 2—3 cells and reach a height of about 35 μ; the cells contain some irregularly shaped small chromatophores.

In the middle of the disc the cells in the upper end of the assimilating filaments were divided by longitudinal walls being at the same time also darker coloured, this most probably being the beginning of the plurilocular sporangia. Above these divided cells the epidermis of the mother cell was often present in the mucilage. No further developed sporangia were found and a more definite determination is therefore impossible.

Only found once, St. Thomas: at the shore of Water Island.

## *Fam. 5.* ***Ralfsiaceæ.***

### **Ralfsia** Berk.

#### 1. **Ralfsia expansa** J. Ag.

J. Agardh, Species Algarum, I, p. 63. F. Børgesen, Two crustaceous brown algæ from the Danish West Indies (Nuova Notarisia, Serie XXIII, 1912). A. Weber, Algues du Siboga, I, p. 146.

*Myrionema* (?) *expansum* J. Ag., Nya alger fran Mexico (Öfversigt af K. Vetenskaps-Akademiens Förhandlinger, 4, 1847, p. 5, Stockholm 1848).

Though using the name of J. Agardh for this plant I may point out that the description of Agardh (l. c.) is so poor that an identification by means of it is impossible and as, moreover, the original specimen of *Ralfsia expansa*, collected by Liebmann at Vera Cruz and now in the Botanical Museum, Copenhagen, is sterile, an exact identification by means of it is also excluded. The using of Agardh's name in spite of this is chiefly because the sterile thallus of Liebmann's specimen seems quite to agree with my specimens and furthermore also, because the plant in question has been found in nearly the same flora-district.

The plant when young forms orbicular later on more irregular crusts, often growing together to coriaceous expansions on

stones and rocks. It has a dark brown colour. In young specimens the surface is nearly even and smooth with more or less conspicuous concentric striations, in older ones rather uneven, bullate and often somewhat folded. The thallus is rather easily separated from the substratum.

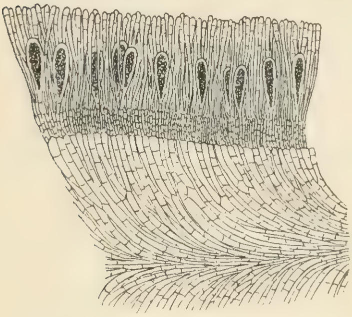

Fig. 20. *Ralfsia expansa* J. Ag. Transverse section of the thallus with unilocular sporangia (40 : 1).

The sterile part of the thallus is built in good accordance with that of *Ralfsia verrucosa*: from a horizontal layer of cells, arch-formed cell-threads grow up turning their convex side against the edge of the thallus, forming in this way a parenchymatical layer in good agreement with Reinke's schematic figure of *Ralfsia verrucosa* in "Algenflora" p. 48; often the leaf is more or less bilateral as shown in Figs. 20 and 21 being like the figure *c* of Reinke l. c., referring to some form from the Channel of *Ralfsia verrucosa* and in this way showing much likeness to *Ralfsia deusta*.

The chromatophore in the material preserved in alcohol was not especially prominent; it was plate-shaped and a single one was found in each cell.

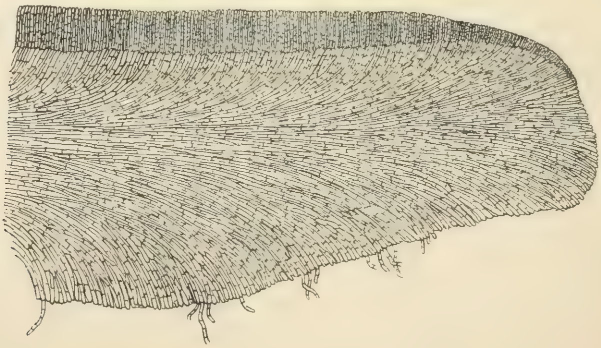

Fig. 21. *Ralfsia expansa* J. Ag.
Transverse section of the thallus near the edge (40 : 1).

Groups of hairs occur rather abundantly.

Both unilocular and plurilocular sporangia were met with, occurring on different plants. The unilocular sporangia (Fig. 22 *a* and *b*) are laterally placed upon the assimilating filaments and

nearly always stalked, having a single basal cell, very seldom I have found sporangia without this cell. They are oblong-pyriform; but as to the form and size some differences occur. In one specimen from the reef between the Hurricane Island and St. Thomas they were nearly oval-pyriform, 75 $\mu$ long and 30 $\mu$ broad and the assimilating filaments about 100 $\mu$ long (Fig. 22 *a*); in another specimen collected at the French wharf in the harbour of St. Thomas they were much longer, oval-pyriform to clavate

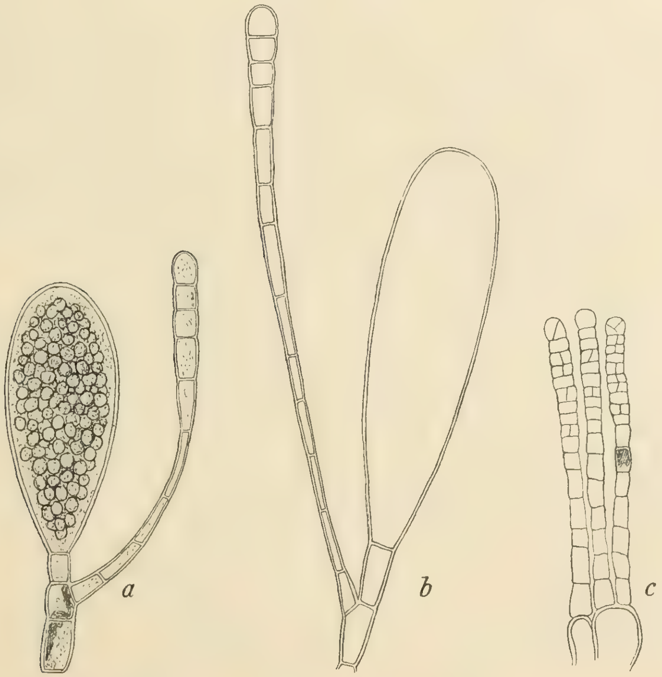

Fig. 22. *Ralfsia expansa* J. Ag.
*a* and *b*, unilocular sporangia; *c*, plurilocular sporangia. (About 300 : 1).

until 120 $\mu$ long without the basal cell and 30 $\mu$ broad and the assimilating filaments up to 170 $\mu$ long (Fig. 22 *b*).

The assimilating filaments consisting of from 8 to 14 cells are thinnest (about 3 $\mu$) and the cells of which they are composed longest somewhat below their middle, the cells growing thicker and shorter towards their base and especially towards their top, the filaments assuming herewith a clavate appearance.

The plurilocular sporangia (Fig. 22 *c*) are formed by the assimilating filaments, the cells in their uppermost part being

divided by vertical and horizontal walls into smaller, more or less cubical cells. The sporangia are about 5—6 $\mu$ thick.

So far as I can see, this form seems to be very nearly related to *Ralfsia verrucosa* and especially it comes near to that large form collected by SCHOUSBOE in Maroc and described by KUCKUCK in "Bemerkungen zur marinen Algenvegetation von Helgoland", I, p. 244. The most essential differences between the West Indian form and *Ralfsia verrucosa* are, that the sporangia in the first-mentioned form seem to be somewhat longer sometimes nearly clavate, that the sporangia have a small cell at their base, which is not mentioned in KUCKUCK's description nor found in the excellent figures of *Ralfsia verrucosa* in REINKE's "Atlas"; only in HARVEY, "Phycologia Britannica", pl. XCVIII, fig. 5 such a cell is figured. As to the plurilocular sporangia a difference is also present, the large top cell of the sporangia in *Ralfsia verrucosa* being after KUCKUCK, l. c. p. 242, colourless and sterile. On the other hand, the paraphyses of the West Indian form seem quite to agree with those of *Ralfsia verrucosa.*

So long as our knowledge of *Ralfsia verrucosa* and its different forms remains somewhat deficient (cfr. REINKE, l. c. and KUCKUCK, l. c.) I think it most correct to consider our form as a special species. Should later examinations of the different forms now referred to *Ralfsia verrucosa* show, that they all really belong to this species, it would perhaps be most natural to consider the West Indian form also as a variety of *R. verrucosa.*

This species occurred in shallow water near the surface of the sea on rocks and stones in rather exposed as well as more sheltered localities. It is found with unilocular and plurilocular sporangia in the months December—March.

It is a common species at the shores of the Danish Islands, especially at St. Thomas and St. Jan.

Geogr. Distrib. West Indies, Indian Ocean.

## *Fam. 6. **Lithodermataceæ.***

### **Lithoderma** Aresch.

#### 1. **Lithoderma** spec.

Upon a stone together with *Ralfsia* were found some thin crusts of a brown alga. It has marginal growth and consists of a basal layer of cells from which the erect filaments grow upwards (Fig. 23).

The basal cells are oblong rectangular and arranged in fairly clear rows, occasionally dichotomously divided (Fig. 23 *b*).

From these cells the assimilating filaments grow up. These are likewise now and then dichotomously divided and composed of rather short cells; the diameter of the filaments, which are rather firmly connected, is about 8—10 $\mu$.

The chromatophores were not very clear, even after having been stained; nevertheless I think that each cell contains a few irregular discs.

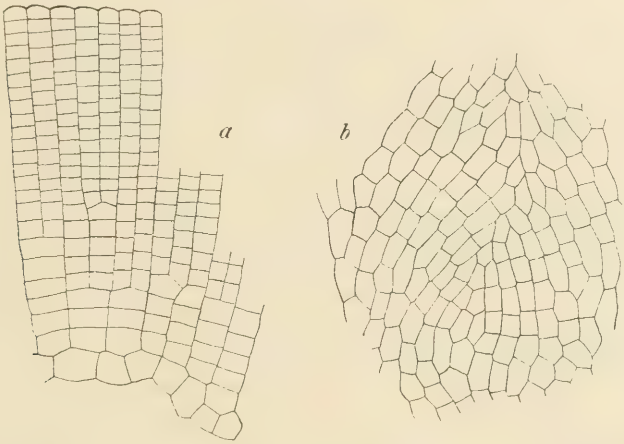


Fig. 23. *Lithoderma* spec.
*a*, transverse section of thallus. *b*, part of the disc. (About 200 : 1).

As the plant was sterile any more precise determination was excluded.

Only found once upon a stone in quite shallow water.

St. Jan: Cruz Bay.

## *Fam. 7.* ***Cutleriaceæ.***

### **Aglaozonia** Zanard.

#### 1. **Aglaozonia canariensis** Sauv.

C. Sauvageau, Observations sur quelques Dictyotacées et sur un *Aglaozonia* nouveau (Bulletin de la Station biologique d'Arcachon, 8, 1904 5).

Børgesen, F., Two crustaceous brown algæ from the Danish West Indies (Nuova Notarisia, Serie XXIII, 1912).

On the exposed coast of the rocky north-west side of St. Croix I have collected a crust-shaped alga which seems quite to

agree with *Aglaozonia canariensis* described by Sauvageau. As his preliminary note on this alga is without any figures and a certain identification therefore was difficult, I have sent a drawing to Professor Sauvageau and asked him if my supposition was correct. Professor Sauvageau quite agreed with me and has also most kindly sent me some material of his plant, to compare with the mine.

As already mentioned, my plant was found on exposed coasts and it was here growing as large expansions covering the rocks

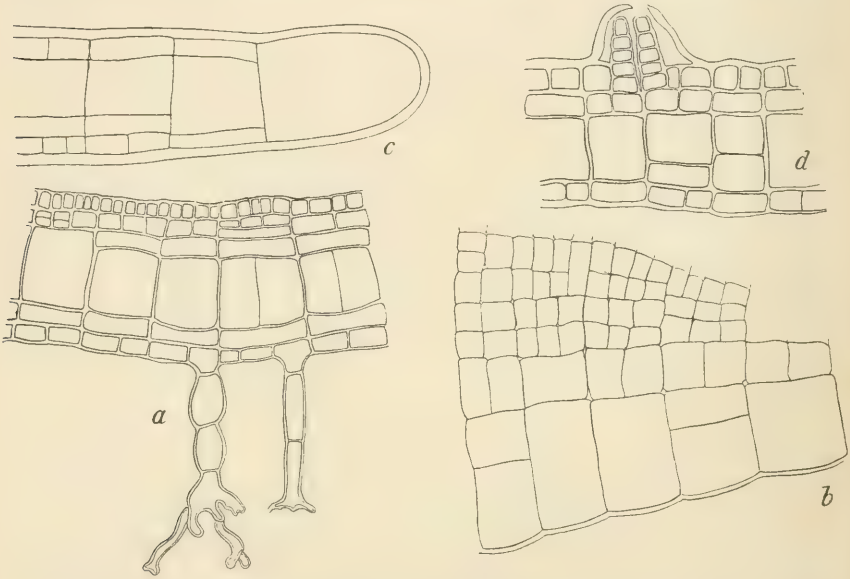


Fig. 24. *Aglaozonia canariensis* Sauv.
*a*, transverse section of the thallus with rhizoids. *b*, edge of the thallus seen from above. *c*, transverse section of the edge of the thallus. *d*, transverse section of the thallus with young hairs. (About 70 : 1).

with a dark-brown crust. It is of a coriaceous consistency. The edges of the thallus are roundish lobed and the lobes grow more or less over each other in a similar way as in *Ralfsia*. It adheres firmly to the substratum by means of numerous multicellular rhizoids (fig. 24 *a*) ending in a disc with irregularly divided, often coralliform prolongations. The cells in the unbranched part of the rhizoids are often swollen in the middle, this assuming thereby a moniliform appearance, but quite cylindric cells also occur.

If we examine the thallus from above (Fig. 24 *b*) we find

that it is composed of numerous rows of cells radiating flabelliform out from the margin; along this we find a series of large cells and these divide themselves gradually by longitudinal and transverse walls, each in this way giving rise to 2—4 rows of cells. In a transverse section (Fig. 24 *a*) we find that the thallus consists of a medullary layer of large cells with dark brown contents in the middle, and one or two, on the upper side occasionally even three, large flat cells; at the surface on both sides an epidermal layer of small cells. The large flat cells nearest the periphery are most often, in any case in older parts of the thallus, divided by vertical, secondary walls into two to four cells, more seldom horizontal walls also occur.

A transverse section of the edge (Fig. 24 *c*) shows the development of the thallus. First by a vertical wall a large cell is cut off from the topcell and at the new cells upper and under side two flat cells are formed from which the epidermal layer has it origin, the cells on the upper side being gradually divided into 4—6 small cells those below most often only in two or not at all (comp. Fig. 24 *a*). From the large cell in the middle of the thallus one, two or sometimes even three flat cells are cut off on the upper side, one or sometimes two from its under side. While these cells on the side below most often are undivided, sometimes though divided by a vertical wall into two cells, those on the upper side are somewhat more divided especially the uppermost cells. The large cells in the middle are sometimes also divided by vertical walls into two cells (the two cells to the right in Fig. 24 *a*).

The rhizoids are outgrowths from the epidermal cells below. Upon the upper side of the thallus here and there scattered groups of hairs occur; the hairs have their origin from epidermal cells (Fig. 24 *d*).

Unfortunately all my material was sterile.

As will be clear from this description, my plant seems to agree with that of Sauvageau, only that it is sterile, and this I have also confirmed by examination of original material from the Canary Isles which Prof. Sauvageau has most kindly sent to me.

In my preliminary paper I have pointed out that *Ralfsia ceylanica* Harv. most probably belongs to this species. And the same I think is also the case with *Zonaria parvula* Grev. var. *duplex* Heydrich.

In the Danish West Indies *Aglaozonia canariensis* was found on very exposed coast incrusting the rocks at about high water

mark and somewhat below. It was gathered in February and was then sterile.

St. Croix: at Northside estate.

Geogr. Distrib. Canary Isles, Indian Ocean?

## *Fam. 8. Sphacelariaceæ.*

### Sphacelaria Lyngb.

#### 1. Sphacelaria tribuloides Menegh.

Meneghini, Lettere al Corinaldi, 1840, p. 2, No. 1 (non vidi).

Sauvageau, C., Remarques sur les Spacélariacées, p. 123 and p. 237. (Extr. du Journal de Botanique, 1900—1904).

Vickers, A., Phycologia Barbadensis, Part II, pl. XXVI.

Specimens occurred with propagula and plurilocular sporangia.

This species is found growing upon stones, shells and similar objects.

It occurs in the upper sublittoral and in the littoral region and in both exposed and sheltered places.

St. Croix: Northside. St. Thomas: The Harbour, Water Island, Store Nordside Bugt.

Geogr. Distrib. All warm and temperated seas as far north as Scotland in the Atlantic.

#### 2. Sphacelaria furcigera Kütz.

Kützing, Fr., Tabulæ Phycologicæ, vol. V, p. 27, tab. 90, fig. II.

Sauvageau, C., Remarques sur les Sphacélariacées, p. 145. (Journal de Botanique, vol. XV, p. 1901).

Vickers, A., Phycologia Barbadensis, Part II, pl. XXV.

Specimens were found with plurilocular sporangia and propagula.

The plant occurred partly upon stones etc. twisted among other small algæ e. g. *Struvea anastomosans*, partly also upon larger brown algæ, *Sargassum* etc.

It grows in the littoral and upper sublittoral region and is collected in exposed as well as more sheltered places.

St. Thomas: St. Nordside Bugt, the Harbour.

Geogr. Distrib. All warm and temperated seas as far north as Heligoland and the Færöes.

# II. Cyclosporales.

## *Fam. 1.* ***Dictyotaceæ.***

### **Zonaria** Draparn.

#### 1. **Zonaria variegata** (Lamx.) Mert.

Mertens in Martius, Icones plant. cryptog., p. 6, tab. II, fig. II[1]. Richards, H. M., Notes on Zonaria variegata, Lamx. (Proceed. of the American Acad. of Arts and Sciences, 1890). Sauvageau, C., Observations sur quelques Dictyotacées et sur un Aglaozonia nouveau (Bullet. de la Station biolog. d'Arcachon, 8, 1904—5). Vickers, A., Phycologia Barbadensis, part II, pl. VI b.

*Dictyota variegata* Lamx., Essai, p. 57, tab. V, figs. 7—9.

*Gymnosorus variegatus* (Lamx.) J. Ag., Analecta algolog., cont. I p. 11, 1894.

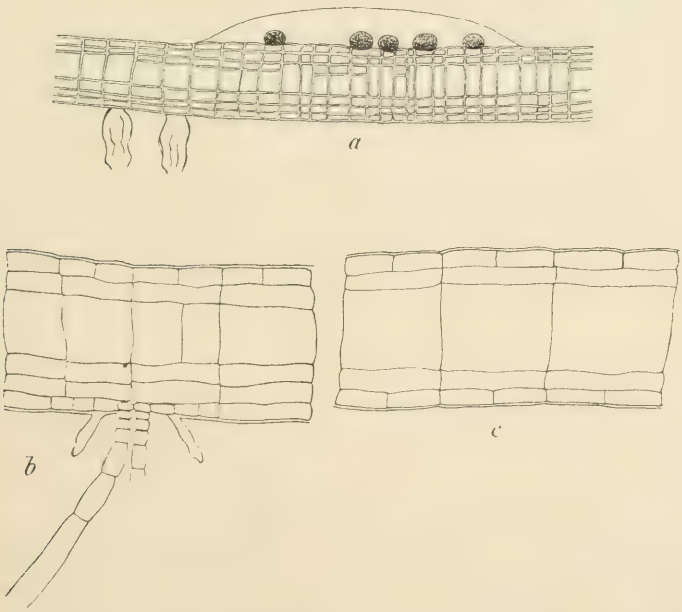


Fig. 25. *Zonaria variegata* (Lamx.) Mert.
Transverse sections of the thallus. *a*, with a young sorus upon the upper side and old, emptied sporangia upon the lower; *b*, with a group of hairs upon the lower face; *c*, of a young thallus.
(*a*, about 50 : 1; *b*, *c*, about 90 : 1).

In the above mentioned important paper, Sauvageau has in much detail described specimens of this plant, collected by him at Teneriffe.

[1]) The figure is rather unlike my specimens.

It is upon this species especially that J. AGARDH has based his new genus *Gymnosorus*, as according to his idea the sori should have no indusium. As pointed out by SAUVAGEAU this is quite wrong, a well developed indusium being present (see Fig. 25 *a*).

On the whole I can confirm the observations of SAUVAGEAU. In the West Indies I have found the plant in deep water only and in the Indian Ocean Mme WEBER has dredged it in depths from 15 to 150 meters; SAUVAGEAU on the other hand found it in shallow water.

I have mostly found the erect form; decumbent, creeping specimens occurred but they were not so firmly attached to the substratum as to be compared with *Aglaozonia canariensis* as SAUVAGEAU has done. But it should be remembered that SAUVAGEAU collected his plant in shallow and perhaps in exposed places where a firm attachment is necessary to the plant. The West Indian plants were found growing upon *Lithothamnion*, pieces of corals and similar bodies, spreading over these, and when reaching the edges the free lobes turn upwards, mostly in an oblique direction, seldom or perhaps never quite vertically. These free lobes reach a length up to 5 cms or more.

In transverse section (Fig. 25) we find that they are only very slightly dorsiventral; as pointed out by SAUVAGEAU an extra layer of cells are found upon the lower face of the erect thallus. Groups of hairs occur upon both sides of the plant; they are usually spread as well in the sterile part and sometimes also in the sori, now and then they are arranged in rather distinct concentric rings.

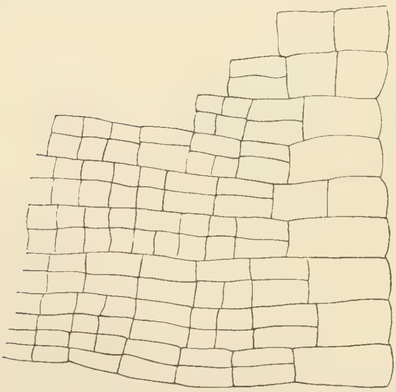

Fig. 26. *Zonaria variegata* (Lamx.) Mert. Margin of the thallus. (About 90 : 1).

The sori especially the smaller ones are often elongated and arranged in concentric rings, but large irregularly formed groups are often present. The sori occur upon both sides of the thallus perhaps most commonly upon the lower face as pointed out by SAUVAGEAU. They have always a well developed indusium (Fig. 25 *a*). As my specimens had either old emptied sporangia or quite young ones I have not been able to see the number of spores in each sporan-

gium. The sporangia are not pedicellated. In my specimens I have not found paraphyses.

I have collected the plant in February and March and as mentioned above in deep water only, from 10—40 meters. It occurred in open sea or in places where strong currents prevailed.

St. Croix: near Buck Island, off Frederiksted. St. Jan: in the Sound between this island and St. Thomas in several places, and near Thatch Island, off Annaberg, Hermitage etc. St. Thomas: in the sea west of Water Island.

Geogr. Distrib. Seems to be common in all warmer seas.

### 2. **Zonaria lobata** Ag.

C. Agardh, Systema Algarum, 1824, p. 265. J. Agardh, Species Algarum, vol. I, 1848, p. 109. J. Agardh, Till Algernes Systematik, II, 1872, p. 46. Harvey, Nereis Bor.-Am., Part I, 1851, p. 105, pl. VII C. C. Sauvageau, Observations sur quelques Dictyotacées et sur un Aglaozonia nouveau. (Bull. de la Station biol. d'Arcachon, 1904—1905, 8e année). A. Vickers, Phycologia Barbadensis, part II, pl. VI.

*Stypopodium lobatum* Kütz., Tabulæ Phycologicæ, vol. IX, p. 25, pl. 63, fig. I.

Of this species I have myself collected only a very few specimens, but I have received several from Mr. O. Hansen Ganneskov collected on the coast of St. Croix but without locality.

The specimens I have collected were taken in shallow water and in a somewhat exposed locality.

St. Croix: Cane Bay.

Geogr. Distrib. West Indies, Brasilia, Canary Isles, Cape, Galapagos Island, Japan?

## **Padina** Adans.

Up to the present time much confusion has prevailed as to the synonomy of the species belonging to this genus.

In her latest large paper concerning the Algæ of the »Siboga« Mme Weber-van Bosse has given very useful information as to several incompletely described species, having examined the original specimens in Herb. Thuret-Bornet, in Herb. Kützing and others and given a detailed description of each.

The characteristic features of the species are based upon 1) the mutual distribution of the organs of propagations and series of hairs, 2) the presence or absence of indusium and 3) the number of cell layers in the thallus.

J. AGARDH[1]) was the first to point out that the mutual arrangement of the hairs and the frutifying organs could be used to distinguish the species. Later on HAUCK[2]) put this into

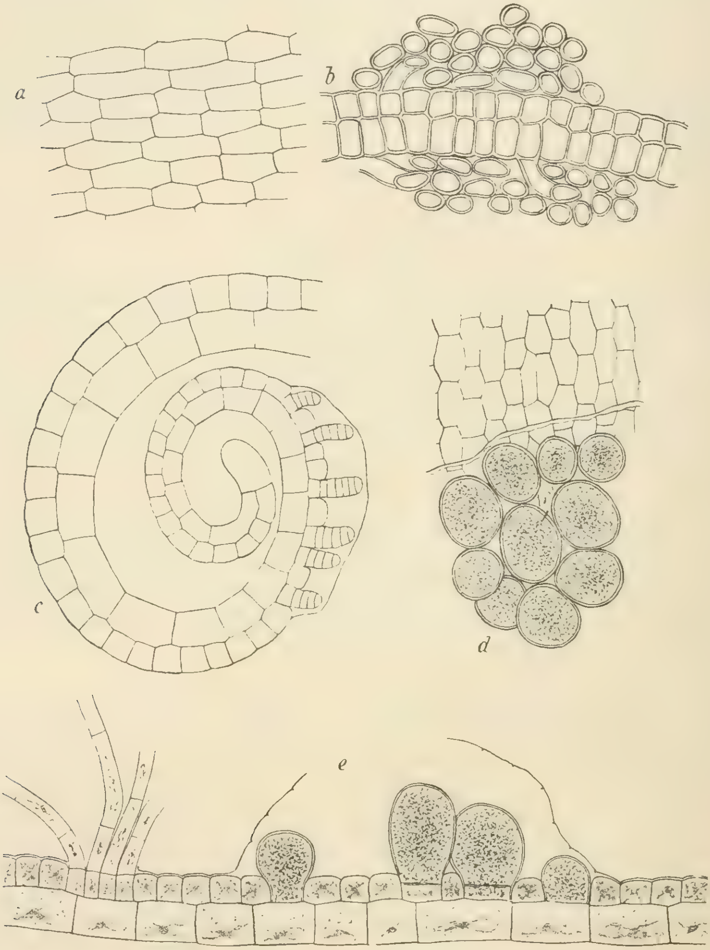


Fig. 27. *Padina Sanctæ Crucis* nov. spec.
*a*, cells from the lower face of the thallus. *b*, transverse section of thallus near the base. *c*, transverse section of the margin of the thallus with a young group of hairs. *d*, vegetative cells from the surface together with sporangia and indusium. *e*, transverse section of the thallus with sporangia and hairs. (About 90 : 1).

[1]) J. AGARDH, Till Algernes Systematik, 2dra Afdeln., p. 115. (Lunds Univ. Årsskrift, T. XVII).

[2]) F. HAUCK, Ueber einige von I. M. HILDEBRANDT im Rothen Meere und Indischen Ocean gesammelte Algen ("Hedwigia", vol. 26, 1887, p.41).

practice and he proposed three groups. His classification ougtht now to be essentially modified after the examination of Mme Weber.

Referring for detail to the paper itself I shall only here mention what has a special interest concerning the West Indian species. Thus it is pointed out that J. Agardh has been wrong in referring *Padina gymnospora*, *P. Antillarum* and *P. variegata* to *P. Durvillaei* and that Hauck also has been mistaken when he refers *P. gymnospora* Kütz., distributed in the exsiccata of Hohenacker (no 515) to *Padina Commersonii*. To be sure Mlle Vickers had even in 1905 *Padina gymnospora* and *P. variegata* in her "Liste des Algues marines de la Barbade" but she gives no reasons for taking up these species. Of course it is most probable that she has got some information from Dr. Bornet.

The West Indian forms collected by me I have referred to the two species of Kützing: *P. gymnospora* and *P. variegata* and further to a new species.

### 1. **Padina Sanctæ Crucis** nov. spec.

Frons membranacea, 10—15 cm alta, pluries subfissa, segmentis terminalibus flabellatis, duobus cellularum stratis composita, rhizoideis numerosissimis e parte basali angustiore ortis adfixa. Pili in zonas concentrales ordinati, sori tetrasporangiorum supra alternas series pilorum concentrice distributi sunt.

As pointed out in the diagnosis this species is characterized by having a distromatic thallus through its whole length (comp. Fig. 27 *b*, *c*, *e*), by the distribution of the tetrasporangia, the latter occurring in broad series along the upper side of every second row of hairs (Fig. 28) and by the presence of a well-developed indusium covering the tetrasporangia-sori (Fig. 27 *d*, *e*).

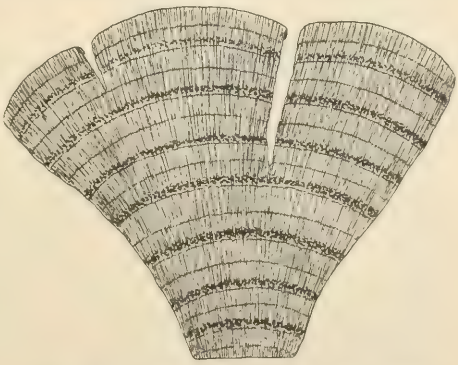

Fig. 28. *Padina St. Crucis* nov. spec. Part of the thallus seen from above showing the mutual arrangement of the series of hairs and tetrasporangia. (About $1^{1}/_{2}$ : 1).

The plant reaches a height of about 10—15 cms and is somewhat incrusted with chalk upon the lower surface, hence the dried plant has here a whitish colour with dark brown rings, while the upper side is yellow brown with darker rings.

As above mentioned the thallus consists of two layers of cells, a thinner one with nearly rectangular cells upon the surface (Fig. 27 *c*, *e*), and a layer of larger cells below. The whole thallus has a thickness of about 90 $\mu$, the cells of the surface of about 35 $\mu$. In the basal part the cells have thick walls (Fig. 27 *b*) and are of nearly the same size upon both side of the thallus; from both cell-layers numerous rhizoids grow out forming a dense cover and below the attachment-disc.

Series of hairs occur upon both sides of the thallus but most richly upon the upper surface.

In several respects this species very much reminds one of *P. gymnospora* having nearly the same arrangement of the tetrasporangia though with the difference that the upper series of hairs occur at some distance from the tetrasporangia; further it differs in the presence of the indusium and by the distromatic thallus.

This species has only been found once in the upper sublittoral region in a somewhat exposed place.

St. Croix: Coakley Bay.

### 2. **Padina gymnospora** (Kütz.) Vickers.

Vickers, A., Liste des Algues de la Barbade (Ann. des sc. nat., Bot., 9e série, t. I, 1905, p. 58); Phycologia Barbadensis, pl. VII. Weber-van Bosse, A., Liste des Algues du Siboga, I, 1913, p. 178—180.

*Zonaria gymnospora* Kütz., Tab. Phycolog., vol. IX, 1859, p. 29, tab. 71, fig. II.

To this species, originally described from St. Thomas I have referred several specimens of which in the following lines I give a more detailed description.

In its upper part near the margin the thallus only consists of two layers of cells namely upon the upward turned side a layer of small cells, in transverse section nearly square, and below a layer of larger cells, rectangular, higher than broad. The thickness of the whole thallus is about 110 $\mu$, while the upper small cells only reach about 35 $\mu$ in height and the larger cells below about 75 $\mu$. Lower down in the thallus the large cells are gradually divided by a horizontal wall (Fig. 29 *a*) and the thallus consists now of three layers of cells. It is the same also near the base but here the cells of the lower face are also divided by vertical walls into small cells similar to those of the upper surface (Fig. 29 *d*).

In the basal part the cell walls are very thick and numerous rhizoids grow out from the surface cells on both side of the thallus. These rhizoids consist of thickwalled, nearly cylindrical

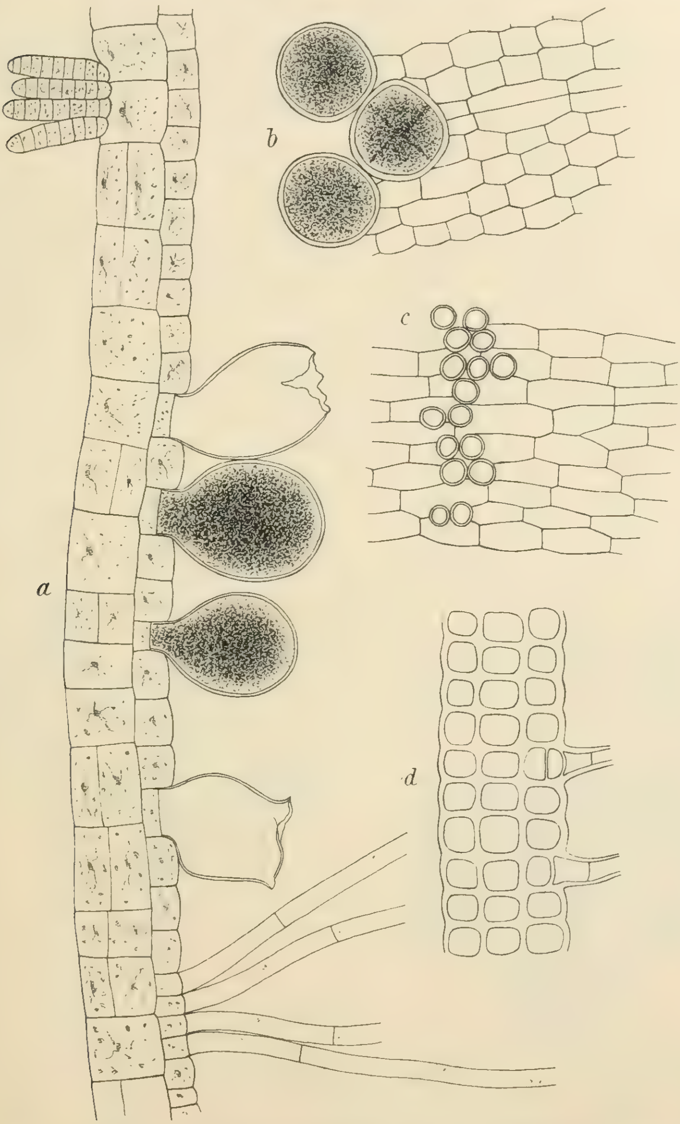


Fig. 29. *Padina gymnospora* (Kütz.) Vickers.
*a*, transverse section of thallus with emptied and not emptied tetrasporangia and hairs. *b*, surface of thallus with tetrasporangia. *c*, lower face of thallus with hairs. *d*, transverse section of thallus near the base. (About 90:1).

cells and are much ramified. They enclose the narrow, basal part of the thallus and form together with it the flattened disc by means of which the plant is fastened to the substratum.

Groups of hairs in concentric rings occur upon both sides of the thallus (Fig. 29 *a*) but mostly upon the upper surface.

The tetrasporangia are disposed mostly in regular concentric rings; these are rather regularly arranged in such a way that each series of tetrasporangia has a row of hairs on each side (Fig. 30).

The groups of tetrasporangia are not covered by any indusium (Fig. 29 *a*, *b*); the tetrasporangia originate each from a single surface cell (Fig. 29 *a*) as already described by Nägeli and Reinke for *Padina Pavonia*. The surface cells are vaulted upwards and when they have grown somewhat they are divided by a horizontal wall near their base into two cells, the uppermost being the sporangia. These are spherical or pyriform of shape and are opened by a large hole at their apex (Fig. 29 *a*).

In referring this form to Kützing's *Zonaria gymnospora* I must point out that compared with the figure of Kützing it differs considerably; for instance the transverse section of the thallus with tetrasporangia (l. c., pl. 71, II, fig. *c*) does not quite agree with what I have found and that the plant near the base should be composed of so many layers of cells as shown in fig. *d* is quite in contradiction to my observations; I only have found 3 layers of cells though surrounded certainly by a thick layer of rhizoids. Yet I want to point out that if we look more carefully at Kützing's figure *b*, representing surface view of thallus with tetrasporangia, we will find that these are drawn in groups and each of these groups is surrounded by a common line, suggesting an indusium, compare my figure 27 *d* of *P. Sanctæ Crucis*; in the corresponding figure of *P. Antillarum* (Kütz., Tab. Phycol., pl. 12, fig. II *d*) such a common ring is not present. How these matters stand in reality is not easy to say without access to original specimens, but in any case Kützing in the diagnosis of *Zonaria gymnospora* says: "sporis nudis".

Fig. 30. *Padina gymnospora* (Kütz.) Vickers. Part of the thallus showing the mutual arrangement of the series of hairs and tetrasporangia. (About $1^1/_2$ : 1).

M^me^ Weber-van Bosse points out that *P. australis* Hauck is very nearly related to this species and from my own observation that the frond of *Padina gymnospora* is distromatic in the upper part of the thallus this relation is yet more evident. Regarding *P. australis* Hauck[1]) himself says: "Der Blattkörper besteht jedoch bis zur Basis nur aus zwei Zellenlagen", but M^me^ Weber has also found specimens with three layers of cells.

*Padina gymnospora* occurs in the littoral and upper sublittoral region and is found both in more sheltered and in quite exposed places. It has been collected with tetraspores in the months Dec.—March.

It has been gathered: St. Thomas, in several places in the harbour; St. Croix: Cane Bay, North Side; St. Jan: Cruz Bay.

Geogr. Distrib. West Indies.

### 3. **Padina variegata** (Lamx.) Hauck.

Hauck, F., Ueber einige von I. M. Hildebrandt im Rothen Meere und Indischen Ocean gesammelte Algen (Hedwigia, vol. 28, 1887, p. 42). Kützing, F., Tabulæ Phycolog., tab. 73, fig. II. Vickers, A., Phycolog. Barbadensis, part II, pl. VIII.

*Dictyota variegata* Lamx., Expos. des caractères du genre Dictyota (Journ. de Bot., t. II, 1809, p. 40).

*Zonaria variegata* C. Agardh, Species Algarum, vol. I, 1823, p. 127.

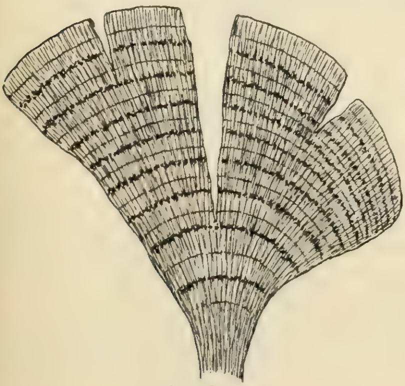

Fig. 31.

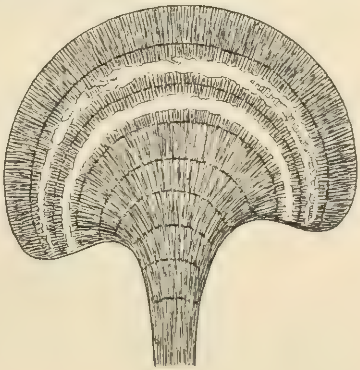

Fig. 32.

Fig. 31. *Padina variegata* (Lamx.) Hauck.
Part of the thallus showing the mutual arrangement of the series of hairs and tetrasporangia. (About $1^1/_2:1$).

Fig. 32. *Padina variegata* (Lamx.) Hauck.
Part of the thallus with series of hairs and antheridia (the white zones). (About $1^1/_2:1$).

[1]) Hauck, F., Ueber einige von I. M. Hildebrandt im Rothen Meere und Indischen Ocean gesammelte Algen ("Hedwigia", 1887, vol. 26, p. 44).

This species has a well developed indusium and is furthermore characterized by the fact that the organs of propagation and the series of hairs alternate regularly (Figs. 31, 32).

At the extreme edge the thallus consists only of two layers of cells, namely: a surface layer consisting of smaller cells nearly square in transverse section and a layer of larger cells below. These last mentioned cells are soon divided by horizontal walls into a number of cells, varying somewhat in the different specimens. The cell-layer below is again divided by vertical walls into small cells similar to those of the surface.

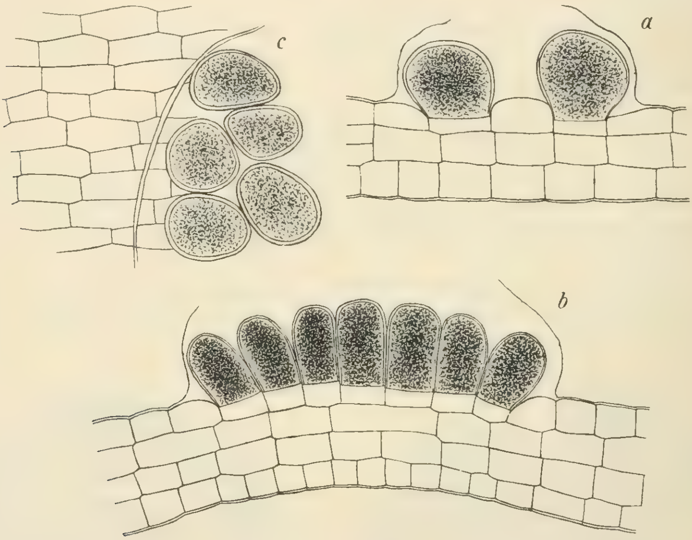


Fig. 33. *Padina variegata* (Lamx.) Hauck.
*a*, transverse section of the thallus with tetrasporangia. *b*, transverse section of the thallus with oogonia. *c*, surface view of thallus with tetrasporangia. (About 90 : 1).

The cells between the two epidermal layers are mostly rather long and flat; we find here up to six layers varying in the different specimens.

Lower down in the thallus near the base almost all the cells are divided into smaller cells nearly quadratic when seen on transverse section (Fig. 34 *b*).

Hairs occur upon both sides of the thallus (Fig. 34 *a*) most numerous upon the surface; sometimes a corresponding series of hairs are found upon both sides of the thallus.

The rows of tetrasporangia are as already mentioned regu-

larly alternating with the series of hairs (Fig. 31); they are placed most often nearest the lower row of hairs. The rows of

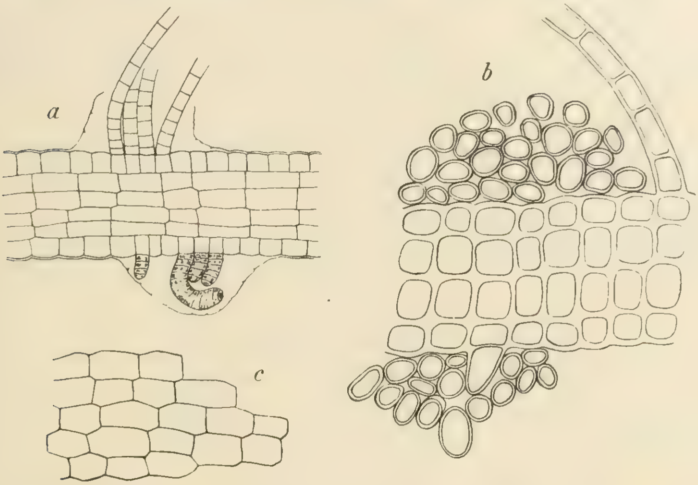


Fig. 34. *Padina variegata* (Lamx.) Hauck.
*a*, transverse section of the thallus with groups of hairs. *b*, transverse section of the thallus with rhizoids near the base. *c*, epidermal cells from the lower fase of the thallus. (About 90 : 1).

tetrasporangia are not always uniform but often separate in dispersed smaller groups of sori. As mentioned above these are

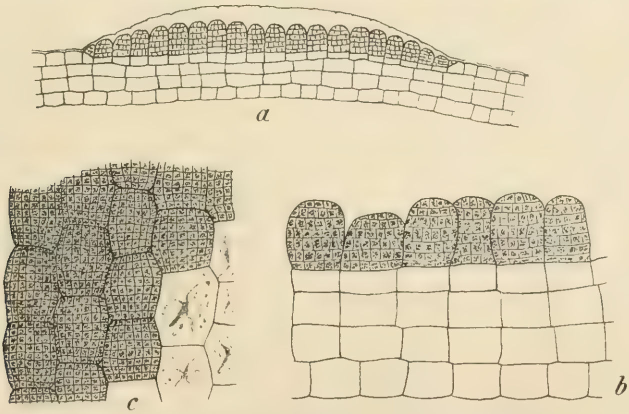


Fig. 35. *Padina variegata* (Lamx.) Hauck.
*a*, transverse section of the antherial zone with indusium. *b*, antheridia. *c*, antheridia seen from above. (*a*, about 50 : 1; *b*, *c*, about 170 : 1).

covered by a well-marked indusium (Fig. 33 *a*, *c*). The shape of the tetrasporangium is roundish pear-shaped.

The oogonia (Fig. 33 *b*) occur in the area of the frond between the series of hairs thus corresponding with the distribution of the tetrasporangia. They are found either in series and then sometimes in two parallel rows, or they are often scattered into numerous small roundish groups. The single oogonium is pear-shaped cylindric with broad base; it is about 80 $\mu$ long and 45 $\mu$ broad.

Of this species I have also collected antheridia-bearing plants. These were rather small, about 2 cm high, and have the antheridia arranged in rather broad series alternating regularly with the rows of hairs (Fig. 32) just as is the case of the tetrasporangia. The antheridia (Fig. 35) are of nearly cubic form, ca. 30 $\mu$ broad and 75 $\mu$ high; they originate from a surface cell and, just as is the case with the mother cell of the tetrasporangia, so here a small cell is cut off at the base. Sometimes I have found antheridia also upon the lower face of the frond and corresponding with the series upon the surface. No trace of oogonia were found in these plants. M^lle^ VICKERS gives a picture of the antheridia of this species but without any description. Judging from the description by HAUCK (l. c.) concerning *P. dubia* the distribution of the antheridia in this species seems to come very near to that in the present plant. On the other hand the distribution of the antheridia in *Padina Pavonia* differs much from our plant. Here the antheridia occur together with the oogonia in the same plant and the antheridia form radiating series at right-angle to the concentric series of oogonia[1]).

This species occurs in the littoral and upper sublittoral region in sheltered or somewhat exposed places. It has been found with tetrasporangia in Dec.—March and with antheridia in December.

It is most probably a common species. St. Croix: Christiansted, Longford, Great Pond. St. Thomas: Store Nordside Bugt. St. Jan: Cruz Bay.

Geogr. Distrib. West Indies.

## **Dictyota** Lamx.

With regard to the determination of the species of this genus I may point out that the very good figures in M^lle^ VICKERS

[1]) REINKE, J., Entwicklungsgeschichtliche Untersuchungen über die Dictyotaceen des Golfs von Neapel. (Nova Acta d. k. Leop.-Carol.-Deutschen Academie, Bd. XL, 1878, p. 24).

"Phycologia Barbadensis" have been of much help to me, the more so since I think Dr. Bornet assisted her a good deal in their preparation.

While some of the species found seem to be fairly well defined, others are much more variable and therefore often difficult to recognize. As is the case with many other algæ so also here the external conditions of life seem greatly to alter the appearance of the thallus. It seems therefore most probable that an examination of a large collection from different localities and in different stages of development will prove that some of the plants now considered as distinct species are really only forms.

### 1. **Dictyota Bartayresiana** Lamx.

Lamouroux, Exposition des caractères du genre Dictyota (Journ. de Botanique, t. II, 1809, p. 43). J. Agardh, Species Algarum, vol. I, p. 94. J. Agardh, Till Algernes Systematik, V, p. 97. J. Agardh, Analecta algol., cont. I, p. 66. Harvey, Nereis Bor.-Am., p. 110, pl. VIII C. A. Vickers, Phycol. Barbad., pl. XII and XIII.

The specimens referred to this species are rather variable; on the whole they agree well with the figures of M^lle Vickers. Some of the specimens also show some likeness with *Dictyota volubilis* and especially with *Dict. pardalis.* The ends of the branches are sometimes acute, sometimes more rounded; M^me Weber-van Bosse[1]) also mentions a form with rounded summits.

Only tetrasporangia-bearing specimens were found. The tetrasporangia occur upon both sides of the frond. They are either solitary or placed a few together and scattered over the whole surface.

This species mostly occurs in shallow water in sheltered places. Often it is lying loose, covering the sandy bottom behind the coral reefs.

Once I dredged it at a depth of about 20 meters.

With the exception of the more exposed coasts it is a common species on the shores of the Danish Islands.

Geogr. Distrib. West Indies, Indian Ocean, tropical Australia.

### 2. **Dictyota linearis** (Ag.) Grev.

Greville, Algæ Britannicæ, p. XLIII. J. Agardh, Species Algarum, I, p. 90. J. Agardh, Till Algernes Systematik, V, p. 101. J. Agardh, Analecta algol., cont. I, p. 77. Kützing, Tab. Phycolog., vol. IX, tab. 21, fig. II.

[1]) Weber-van Bosse, Liste des algues du Siboga, p. 182.

*Dictyota angustissima* Sonder in Kützing, l. c., tab. 21, fig. IV.
*Zonaria linearis* Ag., Species Algarum, I, p. 134.
*Dictyota fibrosa* Kütz., l. c., tab. 15, fig. II.
*Dictyota divaricata* Kütz., l. c., tab. 23, fig. I.

The specimens found were much like the figures of Kützing quoted above.

All were sterile.

They were dredged in the open sea in a depth of about 40 meters.

St Croix: Off Frederiksted.

Geogr. Distrib. Tropical America, Mediterranean Sea, Canary Isles etc.

### 3. **Dictyota volubilis** Kütz.

Kützing, F., Species Algarum, 1849, p. 554.
Vickers, A., Phycol. Barbad., pl. XX.

The specimens referred to this species accord well with the good figure of Mlle Vickers. But how far this form of Vickers rightly is considered as belonging to the species of Kützing seems to me doubtful. In any case it cannot be denied that the figure of Kützing in "Tabulæ Phycologicæ", vol. IX, pl. 13, fig. II, is very different from the West Indian plant. This question can of course only be settled by means of the original specimens.

The most characteristic features of the plant are the marked twisting of the whole frond and the broad sinus between the branches, the angles being often obtuse.

All my specimens were sterile.

This species is found in shallow water and in somewhat deeper, down to a depth of about 10—12 meters. When found in shallow water it was in sheltered places and here it was generally lying loose upon the bottom forming entangled masses.

It has been found: St. Croix: Christiansted, Longford, off Frederiksted and near Buck Island.

Geogr. Distrib. West Indies, Mediterranean Sea?

### 4. **Dictyota pardalis** Kütz.

F. Kützing, Tabulæ Phycologicæ, vol. IX, p 16, tab. 39, fig. II. J. Agardh, Till Algernes Systematik, V, p. 100. J. Agardh, Analecta algolog., Contin. I, p. 68. A. Vickers, Phycologia Barbadensis, pl. XXI.

The specimens considered as belonging to this species were more irregularly dichotomously ramified than *Dictyota volubilis* and not or only very little twisted. Some of the specimens show

much likeness to *Dictyota Bartayresiana*. Mme WEBER has also suggested (in "Algues du Siboga", p. 182) that the present plant may perhaps be nothing more than a form of this species.

The specimens were found in shallow water and in sheltered places only. Most of them were lying loose upon the bottom.

It has been collected, St. Croix: Behind Long Reef, Salt River.

Geogr. Distrib. West Indies.

### 5. Dictyota Indica Sond.

SONDER in KÜTZING, Tab. Phycol., vol. IX, p. 8, tab. 17, fig. I.
VICKERS, A., Phycologia Barbadensis, pl. XVIII.

The specimens referred to this species were much like the figure of Mlle VICKERS (l. c.). They are repeatedly dichotomously ramified and somewhat twisted.

The tetrasporangia and oogonia occur upon both sides of the frond, the first-mentioned in small scattered groups, mostly two to three together.

In the open sea the specimens are rather rigid, in sheltered places more flabby.

When found in the open sea it is usually in deeper water down to a depth of about 10—12 meters, when found in sheltered places it occurs only in shallow water.

St. Croix: off Frederiksted, Longford, near Buck Island, Lt. Princess, Christiansteds Lagoon; St. Thomas: Bovoni Lagoon; St. Jan: Reef Bay.

Geogr. Distrib. West Indies.

### 6. Dictyota ciliata J. Ag.

J. AGARDH, In Historiam Alg. Symbolæ ("Linnæa", XV, 1841, p. 5). J. AGARDH, Spec. Alg., I, p. 23. J. AGARDH, Till Algernes Systematik, V, p. 94. J. AGARDH, Analecta Algologica, Contin. I, p. 75. HARVEY, Nereis Bor.-Am., p. 110, pl. VIII A. F. KÜTZING, Tab. Phycol., vol. IX, pl. 27. A. VICKERS, Phycol. Barbad., pl. XVII.

This species is as well known characterized by the presence of small acute teeth along the margin of the thallus. When it is growing in sheltered places it has a tendency to become proliferous along the margins as shown in the one figure of Mlle VICKERS.

The tetrasporangia occur in small scattered groups on both sides of the frond and contain a few, or up to ten sporangia in each group. The oogonia form small roundish sori also upon both sides of the thallus. And the same is the case with the distribution of the antheridia which form rather large, oblong to oval groups. The single antheridium is about 50 $\mu$ long and 30 $\mu$

broad and somewhat broader upwards. Seen from above the antheridia are more or less quadratic by mutual pressure.

This species is found in much exposed localities and also in quite sheltered. It occurs in shallow water and in deeper, down to a depth of about 10 meters.

It has been collected round St. Croix, at Northside, Longford, Buck Island and in the Lagoon of Christiansted.

Geogr. Distrib. West Indies, Vera Cruz, Red Sea etc.

### 7. **Dictyota crenulata** J. Ag.

J. Agardh, Nya alger från Mexico (Öfvers. k. Vetensk., Akad. Förhandl., 1847, p. 7). J. Agardh, Species Alg., vol. I, p. 94. J. Agardh, Till Algernes Systematik, V, p. 99. A. Vickers, Phycologia Barbad., pl. XVI.

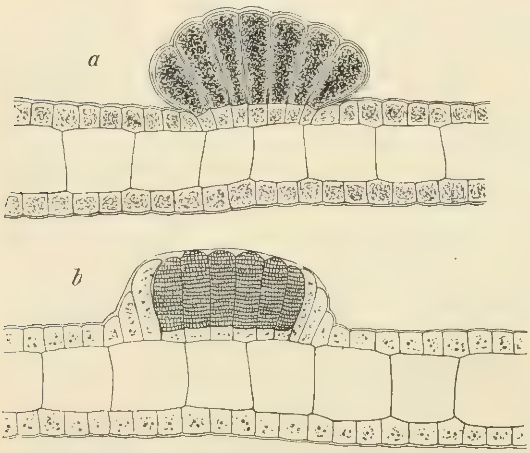


Fig. 36. *Dictyota crenulata* J. Ag.
*a*, transverse section the thallus with oogonia.
*b*, transverse section of the thallus with antheridia.
(About 90 : 1).

In "Species Algarum", l. c., J. Agardh describes *Dictyota crenulata* as: "pulchra et distinctissima species" and in this I agree with him. The specimens found agreed well with the figure of M^lle^ Vickers (l. c.). The plant is rather regularly dichotomously ramified and further characterized by the presence of numerous teeth, shorter or longer, along the margin of the frond. Compared with original specimens from St. Augustin (Mexico) collected by Liebmann, the Mexican specimens seem to be even more irregularly dentate.

In transverse section (Fig. 36) the frond is seen to be composed of a medium layer of large, nearly quadrate cells sorrounded by a layer of small epidermic cells.

Both oogonia- and antheridia-bearing plants were collected; each kind of reproductive-organs occurs upon separated individuals.

The antheridia (Fig. 36 *b*, Fig. 37) form small oval groups

upon both sides of the frond; their development is quite in accordance with those of *Dictyota dichotoma* as described by THURET[1]). They are developed from a group of the epidermal cells. The cells in the periphery of such a group are sterile; these cells are lengthened, mostly the innermost, and bent somewhat towards the middle forming a kind of involucre round the proper antheridial cells in the middle. When the antherial cells have reached a certain length a small basal cell is cut off at their base and the large upper cell is divided very regularly into a great number of quite small cells. Seen from above the antheridia are more or less polygonal by mutual pressure (Fig. 37).

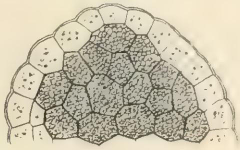

Fig. 37. *Dictyota crenulata* J. Ag. Part of a group of antheridia seen from above. (About 90 : 1).

The oogonia occur likewise upon both sides of the frond and their development is quite in accordance with the description and figures of THURET et BORNET[2]). Groups of epidermal cells become lengthened and when they have reached a certain length a small cell is cut off at their base, while the upper large cells grow into the oogonia. Individuals with tetrasporangia were not found.

Found once only, growing upon buoys in the harbour of Christiansted, St. Croix.

Geogr. Distrib. Pacific Ocean at the shores of Mexico, West Indies.

### 8. **Dictyota dentata** Lamx.

LAMOUROUX, Exposit. des Caract. du genre Dictyota (Journ. de Botanique, t. II, 1809, p. 42). KÜTZING, Species Algarum, p. 556; Tab. Phycologicæ, vol. IX, pl. 35, fig. I. J. AGARDH, Species Alg., vol. I, p. 96. J. AGARDH, Till Algernes Systematik, 2dra afdeln., p. 98. J. AGARDH, Analecta algologica, Contin. I, 71. F. HAUCK, Meeresalgen von Puerto-Rico. (Englers bot. Jahrb., Bd. 9, 1888, p. 466). A. VICKERS, Phycologia Barbadensis, pl. XIV.

All the specimens collected being sterile I cannot give any information as to the organs of reproduction; but HAUCK (l. c.) gives a short description of the tetrasporangia-bearing plants as well as of the oogonia and antheridia which occur in separate plants.

[1]) THURET, G., Recherches sur la fécondation des Fucacées et les anthéridies des algues, 2. partie, (Ann. des Sciences Nat., 4. série, t. III, 1855, p. 5, pl. 2).

[2]) THURET, G. et E. BORNET, Études phycologiques, 1878, p. 53, pl. 27–30.

Besides *D. Brongniartii* J. Ag. HAUCK refers some other species to this plant e. g. also *D. Mertensii* Kütz. Most probably HAUCK is right in referring the latter to this species; in my collection I have not found any form which I feel can be referred to it.

*Dictyota dentata* occurs in shallow water in sheltered places and in deeper water (about 10 meter) in more open sea.

It has been found: St. Croix: At the entrance to Christiansted's Lagoon, Saltriver, Casavagarden, Green Key and near Buck Island.

Geogr. Distrib. West Indies, Brazil.

## Dilophus J. Ag.

### 1. Dilophus alternans J. Ag.

J. AGARDH, Till Algernes Systematik, V, Dictyoteæ, p. 108; Analecta algologica, Continuatio I, 1894, p. 93. A. VICKERS, Phycologia Barbadensis, pl. X.

The specimens found agrees well with the figure of M[lle] VICKERS (l. c.). All were sterile.

This species has been found in the upper sublittoral region and in somewhat sheltered places.

It was collected, St. Croix: Lime Tree Bay; St. Jan: Coral Bay.

Geogr. Distrib. West Indies and surrounding coast.

### 2. Dilophus guineensis (Kütz.) J. Ag.

J. AGARDH, Till Algernes Systematik, 2dra Afd., p. 108. J. AGARDH, Analecta algologica. Cont. I, p. 89. A. VICKERS, Phycologia Barbadensis, Part II, pl. IX.

*Spatoglossum guineense* Kütz., Phycologia generalis, p. 339; Species Algarum, p. 560; Tabulæ Phycologicæ, vol. IX, pl. 46, fig. I.

In the upper part of the thallus the flat frond consists of a single layer of large cells surrounded by a layer of small epidermical cells (Fig. 39 *a*). Lower down in the thallus we find in transverse section the large cells to be divided mostly into two layers of cells (Fig. 39 *b*) sometimes in the middle of the frond even into several layers.

The base of the plant consists of terete, rhizome-like filaments composed of several cells with thick walls. These filaments are creeping and from their lower side numerous rhizoids grow out ending with small attachment discs fixed to the substratum.

The tetrasporangia (I take it for granted that they are such but I have not seen their actual divisions) occur upon both sides of the lobes of the flat frond. They are scattered or some few together, sometimes also confluent into larger sori. They are nearly spherical and have no indusium. Their diameter reaches a length of about 100 $\mu$ and more. Scattered between the tetrasporangia groups of hairs are present.

This species originally described from specimens from St. Thomas seems to be a common species on the Danish Isles. It has been found in much exposed as also in sheltered places and in shallow water and deeper down to a depth of about 10 meters.

St. Croix: Northside, Casavagarden, Longford, near Buck Island.

Geogr. Distrib. West Indies.

Fig. 38. *Dilophus guineensis* (Kütz.) J. Ag. Part of the thallus with tetrasporangia. (About 12 : 1).

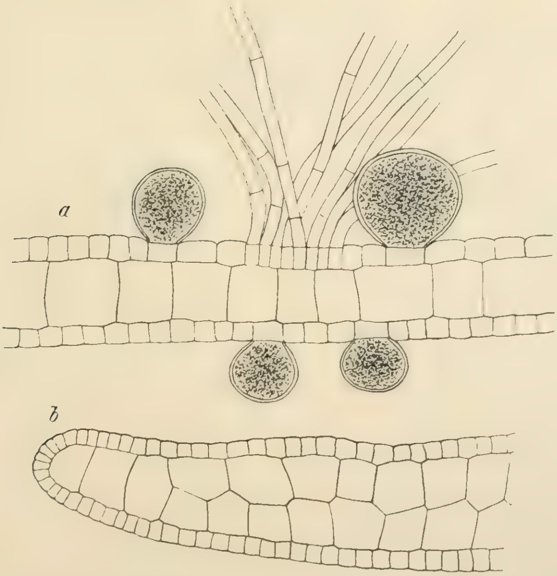


Fig. 39. *Dilophus guineensis* (Kütz.) J. Ag.
*a*, transverse section of thallus with tetrasporangia and hairs. *b*, transverse section of a sterile part of the thallus. (About 100 : 1).

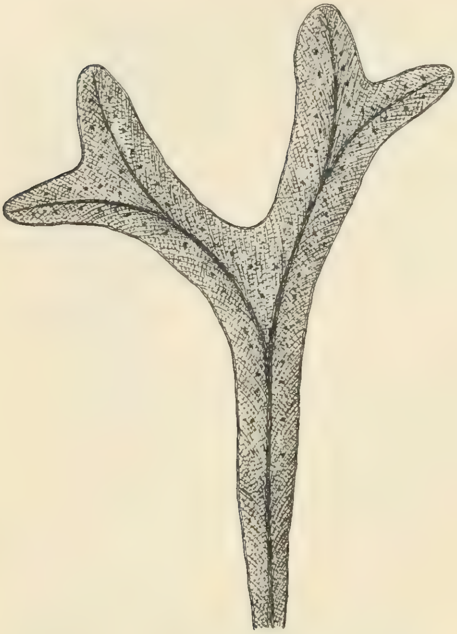

Fig. 40. *Dictyopteris delicatula* Lamx. A part of the thallus. (About 3 : 1).

## Dictyopteris Lamx.

### 1. D. delicatula Lamx.

Lamouroux in Journ. Philom., 1809, no.20, tab.6, fig.B. A. Vickers, Phycologia Barbadensis, part II, pl. III.

*Haliseris delicatula* C. Ag., Species, p. 144. J. Agardh, Spec. Alg., vol. I, p. 116. Kützing, Tabulæ Phycologicæ, vol. IX, pl. 56, fig. II.

The thallus consists of two layers of cells (Fig. 41 *a*) with the exception of the ribs in the edges and in middle of the frond where it is composed of several layers of cells. In transverse sections these ribs are seen to contain a string composed of cells with very thick walls in which pores are present (Fig. 41 *b*). Of these M[lle] Vickers reproduces figures drawn by Bornet. The wall consists of cellulose; it is coloured blue by chlor-zinc-iodine. In a longitudinal section the cells of the strings are found to be long, cylindrical with oblique end-walls.

The hairs are only present upon the one side of the thallus; they are placed many together in roundish or oval groups and occur regularly upon both sides of the mid-rib.

In the basal part the plant is fastened to the substratum by means of rhizoids. These grow out partly from the cells along the margin of the thallus

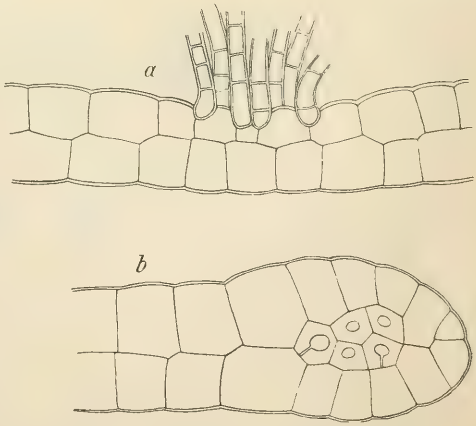


Fig. 41. *Dictyopteris delicatula* Lamx. *a*, transverse section of the thallus with a group of hair. *b*, transverse section of the edge of the thallus.

and partly from the cells above the midrib. The rhizoids consist of cylindrical cells 6—8 times as long as their own diameter and end with a small irregularly lobed disc. These rhizoids can grow out from any parts of the thallus which come near to the substratum.

Only sterile plants were collected. They were gathered in shallow water and in a sheltered place.

St. Croix: Lime Tree Bay.

Geogr. Distrib. The West Indies, Mexico, Brazil etc.

### 2. **Dictyopteris plagiogramma** (Mont.) Vickers.

Vickers, A., Liste des Algues de la Barbade (Ann. sc. nat., Bot., 9e sér., t. I, 1905, p. 58); Phycologia Barbadensis, part. II, pl. IV.

*Haliseris plagiogramma* Montagne, Centurie de plantes cell. exot. nouv. (Ann. sc. nat., Bot., 2e sér., t. 8, 1837, p. 356).

In a collection of algæ which were sent me by Mr. O. Hansen Ganneskov I found a single specimen of this beautiful plant. It was provided with tetrasporangia. These occur in small groups 2—3 together which often coalesce into larger ones. They are found in the middle of the frond and form a broad row placed on both sides of the midrib.

The plant was gathered at the shore of St. Croix.

Geogr. Distrib. West Indies, Brazil, Pacific Ocean, Australia.

### 3. **Dictyopteris Justii** Lamx.

Lamouroux in Journ. Philom., 1809, no. 20, tab. 6, fig. A. Vickers, A., Phycologia Barbadensis, part II, pl. V.

*Haliseris Justii* C. Agardh, Species Alg., vol. I, p. 142. J. Agardh, Species Algarum, vol. I, p. 118.

The specimen collected is so small that a certain determination is impossible.

It was dredged in deep water about 20 meters in the Sound between St. Thomas and St. Jan: off Cruz Bay.

Geogr. Distrib. West Indies.

## *Fam. 2.* ***Fucaceæ.***

## **Turbinaria** Lamx.

### 1. **Turbinaria trialata** Kütz.

Kützing, Tab. Phycol., vol. X, 1860, p. 24, tab. 67. Barton, E. S., A systematic and structural account of the genus Turbinaria Lamx. (Transact. Linn. Soc. of London, 2. Ser., Bot., vol. III, 1891, p. 218).

The specimens found (Fig. 42) agree very well with the description of Mrs. GEPP (née BARTON) l. c. In one specimen from Coral Bay, the lowermost peltate leaves had no vesicles, these were on the other hand well developed in the upper fructifying part of the plant.

It is found in fruit from December to March.

*T. trialata* occurs together with species of *Sargassum* in the littoral and uppermost sublittoral region and on exposed as well as more sheltered places.

Fig. 42. *Turbinaria trialata* Kütz. (About natural size).

It is a common species along the shores of the Danish Isles.

Geogr. Distrib. Seems to occur in all warm seas.

## **Sargassum** C. Ag.

### 1. **Sargassum vulgare** C. Ag.

C. AGARDH, Species Algarum, vol. 1, p. 3. J. AGARDH, Species Sargassorum Austral., p. 108. A. VICKERS, Phycologia Barbadensis, part II, pl. II. F. BØRGESEN, in Mindeskrift for Japetus Steenstrup, 1914, No. XXXII, p. 3.

*Fucus natans* Turner, Fuci, p. 99 (101), pl. 46, fig. a.

var. *typica*. (Fig. 43).

The specimens which I have referred to the typical form are very much like the figure given by TURNER (l. c.). The linear-lanceolate leaves possess a dentate-sinuate margin, a distinct midrib, and quite numerous, but small and irregularly placed cryptostomata; the latter are sometimes very indistinct or quite absent in some of the leaves.

The vesicles are sometimes few, sometimes numerous; they are globular, of the size of a small pea, and most often they are without prolongations at the top; such ones occur, however, now and then.

The receptacles are cylindric, filiform and irregularly ramified.

var. *foliosissima* (Lamx.) J. Ag.

J. Agardh, Spec. Sargassorum Austral., p. 108.

*Fucus foliosissimus* Lamouroux, Essai Thalassiophytes (Ann. du Muséum d'Hist. nat., vol. 20, 1813, p. 36, pl. 7, fig. 1).

This form is different from the typical one by having numerous, closely packed leaves which are smaller, proportionally shorter, and more or less undulate, frequently somewhat twisted.

The receptacles are shorter and similar to the vesicles hidden between the leaves.

This species is very common along the shores of the islands and occurs in exposed or sheltered places. In exposed localities, where the sea constantly splashes the rocks, *Sargassum vulgare* is able to thrive above the ordinary water mark; in the more sheltered places it occurs close to it, or a little below.

*Sargassum vulgare* is the dominant species in the *Sargassum*-vegetation forming with *Turbinaria trialata* a vegetation of large, brown algæ corresponding with the Fucaceæ-vegetation in northern seas.

Fig. 43. *Sargassum vulgare* C. Ag. Part of a plant with receptacles and vesicles. (A little over natural size, about 1/6 magnified).

Geogr. Distrib. This species is said to occur at nearly all subtropical and tropical shores of the Atlantic Ocean: America and the West Indies, Africa, Spain etc.

### 2. **Sargassum lendigerum** (L.) Kütz.

Kützing, Species Algarum, p. 612; Tabulæ Phycologicæ, vol. XI, tab. 19, fig. II. J. Agardh, Species Sargassorum Austral., p. 110. F. Børgesen, l. c. p. 4.

*Fucus lendigerus* L., Species plant., p. 1628. Turner, Fuci, p. 107, tab. 48.

The specimens which I have referred to this species possess leaves with a distinct midrib and small, most often scattered cryptostomata; these are, sometimes, arranged more or less regularly in a single series on both sides of the midrib.

The basal leaves are more or less dentate; the upper have a somewhat sinuate to entire margin.

The leaves are linear-elliptic 4—5 mm. broad, and up to 3 cm. long, with a short stalk or sessile. The vesicles are scarce, often quite absent; when present, according to my observations, they occur only at the upper end of the branch; they reach the size of a small pea, and are often somewhat oval, now and then provided with a small, leaf-like prolongation at their apex.

Fig. 44. *Sargassum platycarpum* Mont. Part of a branch with receptacles and vesicles. (About 1/6 magnified).

The receptacles are mostly aggregated at the upper end of the branches; they are cylindric and irregularly branched.

This species appears to be closely related to *Sargassum vulgare*, representing probably merely variety of it.

St. Thomas: Store Nordside Bugt, growing in a rather exposed place.

Geogr. Distrib. West Indies, Bermuda, Teneriffa etc.

### 3. **Sargassum platycarpum** Mont.

Montagne, Cent. III, p. 18, n. 51; Sylloge generum specierumque Cryptogamarum, 1856, p. 385. J. Agardh, Species Sargassorum Austral., p. 89, tab. VI. A. Vickers, Phycol. Barbad., Part II, pl. II. F. Børgesen, l. c., p. 5.

Characteristic of this species (Fig. 44) are the rather large, often oval cryptostomata, arranged in a single series on both sides of the midrib. The leaves are lanceolate, dentate along the margin. The vesicles are not very numerous; in the diagnosis in "Sylloge", l. c., Montagne writes: "vesiculis nullis". In my specimens the vesicles were only noticed in the fertile part of the thallus; they are globular, sometimes ellipsoid, now and then with a short prolongation at the top.

The receptacular branches are flat, bearing long projections at their margin.

The species was found on rocks close to, or a little above the surface of the sea, in rather exposed or somewhat sheltered places.

St. Croix: Green Cay, Coakley Bay, Long Reef.

Geogr. Distrib. West Indies and warmer shores of America.

### 4. Sargassum Hystrix J. Ag.

J. Agardh, Nya Alger från Mexico (Öfversigt K. Vet. Akad. Förhandl. 1847); Spec. Alg., p. 322; Species Sargassorum Australiæ, p. 91, tab. VII, figs. 1—5. F. Børgesen, l. c., p. 5.

*Carpacanthus spinulosus* Kütz., Tab. phycol., vol. XI, p. 15, tab. 46, fig. 2.

As pointed out in my paper quoted above the two rather damaged specimens found floating in the sea and referred to this species closely resemble the figure of *Carpacanthus sptnulosus* of Kützing. As characteristic of my specimens and as it seems judging from his figure in accordance also with Kützing's, may be pointed out (1) that the rather thin leaves have a strongly serrated or dentated margin and many small cryptostomata spread over the whole surface, (2) that the branched receptacles are provided with acute processes along the margin; and (3) that the vesicles are rather thin-walled. How far this form of Kützing's really belongs to *Sargassum Hystrix* J. Ag. seems to me rather doubtful.

In order to obtain clearer light in the matter I paid a visit to Lund to compare my specimens with the original material in J. Agardh's Herbarium. These latter agreed well with those in the Herbarium of the Botanical Museum at Copenhagen, all the specimens being collected by Liebmann at Campeche Banks. From my specimens these plants differ in several respects. For instance most of the different organs of the plant seem to be smaller and markedly firmer and darker coloured; the vesicles are mostly somewhat smaller and have thicker walls, the leaves are smaller but thicker and have only a few but larger cryptostomata though these may be often quite wanting. The receptacles are shorter, but broader. I happened to come into correspondence with Mr. A. Gepp concerning this question and asked him if there was much material of *Sargassum Hystrix* in the British Museum. In reply to my query he most kindly wrote: — "As to your question about *S. Hystrix*, we have only one trustworthy specimen of it; and that I found some years ago at the end of the genus and bearing these words: — "*Carpacanthus* — Kg. Ins. Ind. occ. Dan." [possibly issued by Hohenacker]. It corresponds exactly with Kütz., Tab. Phyc., XI, tab. 46, II. So I placed it at once under *Sarg. Hystrix.* I noted on it:

"vesicles thin, short-stalked, leaves thin, yellow-brown. Cryptostomata small, scattered. Receptacles very toothed". The receptacles make it appear to be a well marked species". Judging also from this I am inclined to think that KÜTZING's and J. AGARDH's plants do not belong to the same species, but to decide this matter, much more material is necessary than I have had at my disposal[1]).

[1]) In this connection I wish also to point out here that I have had and have now still more doubt as to how far it is justifiable to refer the floating *Sargassum* from the Sargasso Sea (which I in my paper have called *S. Hystrix* var. *fluitans*) to J. AGARDH's species. When I referred it to this plant it was — as I have pointed out in my paper — because J. AGARDH himself had already done so. As mentioned in my paper quoted we have in the Botanical Museum here a specimen of the floating form collected by Capt. ANDREA in the Old Bahama Channel 1/VIII 1870 which J. AGARDH has determined as *Sargassum Hystrix*. This specimen is just like those I have collected in the Sargasso Sea but both this one and also mine are decidedly different from the fixed form collected by LIEBMANN; on the other hand it cannot be denied that the fig. 1 of a sterile plant in J. AGARDH's "Species Sargassorum Australiæ", pl. VII shows much resemblance to the floating form; it differs however in the almost entire absence of cryptostomata[1]) which are most often well-developed and numerous in the floating form though occasionally leaves are found which quite or nearly lack them.

That I considered the floating form different to the fixed I have already shown in that I gave it the rank of variety. But with the further knowledge I now have as to *S. Hystrix* I think it best to consider var. *fluitans* as a proper species coordinate with *S. natans*. As to the origin of *S. fluitans*, we have, just as is the case with *S. natans* only supposition to go upon. It may be derived from *S. Hystrix*, but it might equally well have had other parents.

Herewith a short diagnosis:

**Sargassum fluitans** nov. spec.

*Sargassum Hystrix* J. Ag. var. *fluitans* Børgs. l. c., p. 11, Fig. 8.
*Sargassum Hystrix* J. Ag. ex parte. J. AGARDH, Spec. Sargass. Austral., p. 91.

Axis teretiusculus, ramosus, foliis lanceolatis vel linearibus, margine irregulariter dentato, distincte costatis, cryptostomatibus pro ratione majoribus conspicuisque. Vesiculi numerosi, sphærici, magnitudinem seminis pisi fere æquantes duplo longioribus quam pedicellis eorum.

Long. fol. = ca. 25—30 mm; lat. fol. = ca. 4—5 mm.
Lat. vesic. = ca. 5—6 mm; long. pedicell. vesic. = ca. 3 mm.

[1]) In the text to the plate J. AGARDH says: cryptostomatibus nullis aut obsoletis instructa

6/x 1914.

# INDEX SPECIERUM

(The figures in parantheses refer to the separate copies).

**Bd. 2 • DANSK BOTANISK ARKIV • Nr. 3**
UDGIVET AF DANSK BOTANISK FORENING
1915

# Studies in the Agarics of Denmark[1]).

## Part II.

### Amanita. Lepiota. Coprinus.

By
**Jakob E. Lange.**

With two plates.

## THE GENUS AMANITA.

The genus Amanita, which is made up of large and conspicuous species (some of which are very poisonous, while others are edible) is probably the best figured and described genus of the agarics. The figures of A. muscaria, phalloides etc. are legion, and even the less important species are mentioned and described in almost every mycological textbook.

Still I have not deemed it superfluous in my »Danmarks Agaricaceer« to give watercolour-portraits also of this important genus. Even if most of the prominent species are very well known and cannot easily be mistaken, no little uncertainty exists with regard to some of the more trivial species and certain intermediate forms, the conception of which is rather vacillatory. — And this uncertainty cannot be brought to an end without a synoptic comparison of all the species in question. As, however, many species are rare and may be sought in vain for years, this comparison — practically speaking — can only be brought about by comparing portraits (which — to exclude differences due to the individual artists — should be executed all by the same hand).

Given such a portrait-collection (accompanied by spore-measures and other microscopic data) it will be comparatively

[1]) Part I of this work (General Introduction. The genus Mycena) was published April 17 1914 (Dansk Botanisk Arkiv, vol. I, no. 5).

easy to distinguish the different species clearly and exactly. For while even the most tenacious mind cannot store, nor the most lenghtly description clearly account for the numerous minute details which together characterise a species, they can be seen at a glance on a really carefully executed watercolour-portrait.

In »Danmarks Agaricaceer« I have figured some 14 species — besides several varieties and colour-forms, — 18 plates in all. During more than 20 years of investigation I have not succeeded in detecting any more, except some solitary specimens of dubious identity. — Fries (in »Hymenomycetes Europæi«) describes 37 European species; but of these only 21 (including two rather dubious species) had been observed by himself in Sweden. Thus only 5 of the genuine Swedish species are not included in my collection, which accordingly comprises about $^3/_4$ of the Swedish.

As all these species have been found by me in central Fyn, an area not over 40 × 50 km, it is evident that these fungi are very widely distributed (cnf. *Mycena* in part. I, page 37). The number of species found is the more remarkable when it is taken into consideration, that only some 70 years ago the isle of Fyn had no coniferous woods worth mentioning.

It is well known that the genus *Amanita* has a rather characteristic distribution in Europe, as it comprises a number of southern species (A. cæsarea, coccola, echinocephala a. o.) which are rarely met with beyond the middle of France, Switzerland and Southern Germany, while on the contrary some few species (of the *vaginata*-tribe) seem to be subarctic (f. inst. A hyperborea). In Denmark neither of these are represented. — All the Amanitas seem to be strictly sylvatic.

For purposes of classification the genus Amanita is naturally divided in three groups, which might be termed *Eu-Amanita*, *Amanitopsis* and *Lepiotopsis*. — The main tribe is characterised by having both a distinct universal veil and a ring on the stem, formed by the partial (secondary) veil. In *Amanitopsis* there is no ring, and in *Lepiotopsis* the universal veil is almost obliterate (being reduced to a viscid coating) while the ring is well developed. Amanita lenticularis — the most prominent representative of this group — is therefore by some authors referred to *Lepiota*. But recently Maire has shown (Annales Mycologici 1913) that its microscopic structure is more in accord

with that of the genuine Amanitas; and he therefore proposes to place it — together with Lepiota illinita a. o. — in a new genus, *Amanitella*. Likewise Roze has parcelled out the ringless species into another new genus, which he calls *Amanitopsis*. As long as larger and much more heterogeneous genera are not split up, I do not see any good in carving out new genera of Amanita and shall therefore retain the name in its original Friesian sense.

Fries' systematic arrangement of the genus A. has been but little altered by later authors, nor ought it probably to be. Still by the introduction of microscopic characters, I think it possible, without materially altering the classification, to draw the boundary-lines a little more precisely and attain to a more satisfactory handling of the genus.

The classification of Fries rests almost entirely upon the nature of the universal (and partial) veil: whether it forms a volva with a membraneous free edge or is circumcised or rudimentary. But in a good many cases it is difficult to decide, to which of these types a species belongs. Thus f. inst. A. Mappa is placed by Fries in group I (with a sheath-like volva), A. pantherina in group II; but as a matter of fact the volva of these two species is circumcised in a very similar way. An examination of the spores of the two species will however at once show, that they really do belong to the two different sections, in which they were placed by Fries.

For purposes of classification the form and size of the spores appear to me to be, in this genus, the most important of the available microscopic data. For although the spores do not present very striking differences (as is the case in some other genera), still they are sufficiently different (and constant) to be used for dividing the genus in sections. Thus A. lenticularis (and illinita) has almost globose and small spores, while in the section *Amanitopsis* the spores are also globular, but twice as large. In *Eu-Amanita* two types can be fairly well distinguished: the globular and the ovate; for although the globular spores are not absolutely spheric (but generally taper a little towards the pedicel) and the ovate spores often are very broad, still the outline of the two types is clearly different. The ovate spore characterises the sections II and III of Fries (as well as the South-European edible species of sect. I), while the

poisonous species of sect. I have globular spores. — The spore-membrane is always smooth.

The number of spores on each basidium, in all the species examined by me, is the ordinary 4. Only an American species, *A. bisporigera* Atk., is reported as having 2. — The edge of the gills often (always?) is set with sterile cells (cystidia), which generally are subglobular, in some cases cylindric-vesiculose. But as far as I can see they are of less importance than the spores for purposes of classification.

The universal veil, which macroscopically presents so marked differences (being membraneous, granular, mealy etc.), is generally made up op two types of cells: globose large cells and narrow cylindric ones, which form slender filaments. But the microscopic examination — even of species so different as A. Mappa, A rubescens and A. vaginata — does not materially aid us in discerning the difference in veil-structure: Even the granulated veil does not solely consist of globular cells — as might be expected — but also of filaments.

Spores etc. of all the species are figured on Plate II.

The Key given below is based on the microscopic as well as on the macroscopic characters of the species, and comprises all the species found by me.

# KEY

## TO THE SPECIES OF THE GENUS *AMANITA* FIGURED IN »DANMARKS AGARICACEER«[1]).

### I. EU-AMANITA

Universal and partial veil both present; the former either volvaceous, at base of stem, or forming warts on cap, the latter forming a ring on the stem.

A. **Sphærosporæ.** Spores globose (or almost globose).
  α. volvatæ. Bulb with membraneous free volva; Cap generally naked (without remnants of universal veil).
    a. Cap white. (Ring generally torn, adhering to the gills; stem somewhat fibrillous-scaly) . . . . . . . . . . . . . . . . . . . . . . *A. virosa* (1)
    b. Cap coloured. (Ring entire, stem almost smooth).
      1. Cap olive or yellowish . . . . . . . . . . . . . . . . . . *A. phalloides* (2)
      2. Cap fuscous (dark or very pale) with a red-brownish tint.
        * Bulb large, outside of ring fuscous . . . . . . . . *A. porphyria* (3)
        ⁑ Bulb small, outside of ring yellowish. *A. (porph. var.) recutita* (4)
  β. circumcissæ. Volva circumcised, thus forming a narrow free margin on bulb and warty patches on cap. (cnf. no: 4) . . *A. Mappa* (5)

B. **Ovisporæ.** Spores (generally broadly) ovate.
  [α. volvatæ. A. cæsarea, coccola etc.; no Danish species].
  β. circumcissæ.
    a. Cap scarlet or orange . . . . . . . . . . . . . . . . . . . . . *A. muscaria* (6)
    b. Cap pallid or fuscous (brownish or rubescent).
      1. Flesh not turning reddish when cut or bruised.
        * Bulb globose, with a narrow free margin, ring almost even, warts pure white . . . . . . . . . . . . . . . *A. pantherina* (7)
        ⁑ Bulb ovate (or almost wanting) not distinctly marginate; ring lineate-striate.
          † Warts on cap whitish or pale gray.

[1]) »*Danmarks Agaricaceer*«, which comprises watercolour-portraits of some 800 species painted by me, are executed in duplo, the one belonging to the library of the Bot. Garden of Copenhagen, the other to my own. For further particulars see part I.

° Stem slender, somewhat hollow, deeply seated in the substrate. Universal veil mealy-membraneous, deciduous . . . . . . . . . . . . . . . . *A. excelsa* (8)

°° Stem shorter, firmer, solid; warts mucronate, persistent . . . . . . . . . . . . . . . . . . . . . . . . *A. spissa* (9)

†† Universal veil (warts on cap, on edge of ring and base of stem) more or less sulphur-yellowish . *A. aspera* (10)

2. Flesh (of all parts of the fungus) turning rubescent when cut or bruised . . . . . . . . . . . . . . . . . . . . . . . *A. rubescens* (11)

## II. AMANITOPSIS.

Partial veil absent. Volva sheath-like or circumcised. Margin of cap sulcate. Spores globose, large.

A. Cap naked; volva sheath-like . . . . . . . . . . . . . . . . . . . . *A. vaginata* (12)

B. Cap with large patchy warts or scales; volva circumcised *A. strangulata* (13)

## III. LEPIOTOPSIS.

Universal veil obsolete (neither basal volva nor patches on cap).

Ring present, Cap viscid. Spores small, subglobose . . . . . . *A. lenticularis* (14)

# SYSTEMATIC AND FLORISTIC NOTES ON THE SPECIES.

The following notes give the microscopic data of the several species as well as the locality and habitat of the plants figured. The general distribution of the species is also noted.

Only in cases where any doubt exists as to the identity of the plants in question, or where the views of the authors differ materially, I have deemed it necessary to add some notes on the macroscopic characteristics of the species.

Some critical notes on other species, my opinion about their synonymy etc. will also occasionally be introduced. (Cnf. my remarks in part I pag. 17).

## I. EU-AMANITA.

### A. SPHÆROSPORÆ.

1. **A. virosa** Fr.

Spores globular 8—9$^1/_2$ μ diam., with a tiny pedicel.

Figured from specimens found near Skørping, in wood of Fagus (with some Picea) Sept. 1897. — Rather rare, in mixed woods and pure beech-woods, Aug.—Sept., as well in Jylland as in Fyn.

2 a. **A. phalloides** Fr.

Spores ovate-globular, 9—10 × 7$^1/_2$—8 μ.

Fig. specim. (uncommonly dark-coloured): Hjallese, in wood of Fagus and Corylus, Aug. 1897. — Rather common, especially

in mixed foliaceous woods (Quercus, Fagus and Corylus) on rich humus, often rather numerous, from med. Aug. to end of Sept.

2 b. **A. phalloides** Fr. forma **citrina.**

Spores $8—10 \times 7^1/_2—8\ \mu$. Basidia 4-spored. Edge of gills set with globular cells.

Fig. specim.: Hjallese, copsewood, Sept. 1906. — Much rarer than the olive-green form. — This is *Ag. citrinus* α Pers.

3. **A. porphyria** (Alb. & Schw.).

Spores globular, diam. $7^1/_2$ to $9^1/_2\ \mu$. Ring formed of two strata, the outer one fuscous, the inner white.

Fig. specim.: Skørping, plantation of Picea, mossy ground. — Rather rare, and often solitary, in woods of Picea (Jylland and Fyn).

4. **A.** (**porphyria** var.) **recutita** Fr.

Spores globular, $8^1/_2—9^1/_2 \times 7^1/_2—8^1/_2\ \mu$.

Fig. specim.: Marselisborg Skov near Aarhus, wood of Fagus, several specimens, Oct. 1914. Seems to be rare.

It is hardly a distinct species, only a slender and pale form of no. 3, with smaller, more ovate bulb, paler, almost whitish cap (here and there with patchy remnants of volva, and ring pale yellowish on the outside).

[The fungus described by Sev. Petersen (Danske Agaricaceer, pag. 32) under the name of A. recutita has ovate-ellipsoid spores and seems to be a form of A. excelsa. — My plant is the one mentioned by Quélet & Bataille (loc. cit.) as A. recutita, by Quélet (Enchiridion) made a variety of A. porphyria].

5. **A. Mappa** (Batsch). (*A. citrina* Schaeff.).

Spores subglobose $8^1/_2—9^1/_2 \times 7^1/_2—8\ \mu$.

Fig. specim.: »Fruens Bøge« near Odense, foliaceous wood, Sept. 1897. — Very common in woods of Fagus (even where the soil is rather crusty and dry humus) and also in coniferous woods. It is met with till late in the season (end of October).

## B. OVISPORÆ.

6 a. **A. muscaria** (L.).

Spores broadly oval, $9^1/_2—10^1/_2 \times 7—8\ \mu$.

Fig. specim.: Skørping, wood of Picea, Sept. 1897. — Common, often in great numbers, in (and just outside) coniferous plantations and in woods of Betula (Sept.—Oct.).

6 b. **A. musc.** forma **aureola** (Kalkbr.).

Spores subrotund-ovate, $9 \times 7\ \mu$.

Fig. specim.: Gerup Skov, near Holstenshus, under Betula and Sarothamnus, in grass. Not as distinct variety, only a slender form without warts. — *A. Frostiana* Peck seems almost identical.

7. **A. pantherina** (DC.).

Spores ovate or broadly oval, $8—12 \times 6^1/_2—7^1/_2\ \mu$. — Edge of gills with cells of various shape, mostly cylindric-vesiculose, about $12\ \mu$ broad (1914).

Fig. specim.: Hjallese, wood of Fagus, Oct. 1896 and »Fruens Bøge« Sept. 1905. — Not uncommon, often solitary, chiefly in outskirts of woods of Fagus, occasionally met with in grassy spaces in young plantations of Picea.

The ring is almost even, not conspicuously radiately striate as in the following species. The warts are pure white, the edge of the gills finely crenulate. The colour of the cap varies from dark fuscous-brown to very pale, almost white.

[*A. velatipes* Atk. (from America) appears (judging from the description) to be almost identical].

8 a. **A. excelsa** Fr.

Spores subrotund-ovate, $8—10 \times 5^1/_2—7\ \mu$. Edge of gills set with globular large cells (diam. $20—35\ \mu$).

Fig. specim.: Gerup Skov near Holstenshus, wood of Picea, July 1900. — Rather rare. Appears rather early in the season.

Base of stem deeply set in the substrate; most of the mealy-membranaceous veil is wiped off as the fungus pushes up through the deep layer of dead needles etc., below which it is developed. — It is often paler than shown in my figures; an extreme form is:

8 b. **A. excelsa** Fr. forma **pallida.**

Spores subglobular-ovate, $9 \times 6^1/_2\ \mu$; basidia about $9\ \mu$ broad with 4 sterigms.

Fig. specim.: Same locality as no. 8 a, July 1914.

The surface of the cap is somewhat moist or sub-viscid.

[*A. cariosa* Fr. seems to me only a slender form of A. excelsa. The fungi, which I have called A. excelsa, are almost exactly intermediate between the descriptions of the two species, the larger specimens approaching the excelsa-type, the smaller ones A. cariosa. The larger ones have the innate fibrils of excelsa, and their stem is squamulose, but the base of the stem is only sub-bulbous and the cap rarely reaches the dimensions attributed to A. excelsa.

A. excelsa seems for the rest to be rather differently conceived by the mycological authors. Cooke figures it with a greenish-

olive cap, and SCHROETER (l. cit.) describes the cap as »glänzend gelb« (!)].

9. **A. spissa** Fr.

Spores ovate, $8^1/_2$—$10 \times 6$—$7\,\mu$. Basidia $9\,\mu$ broad with 4 sterigms. Globular cells on edge of gills 18—30 $\mu$ diam.

Fig. specim.: »Fjellebro« near Kværndrup, in wood of Fagus, July 1914. — Rare. The stem is solid, shorter and stouter than in no. 8, not deeply seated in the ground. The warts on the cap are small, in the center somewhat mucronate, pale grayish and rather persistent. It has the habit of A. rubescens, but no trace of reddish.

[*A. valida* Fr. — To judge from the descriptions A. valida and A. spissa show but very little difference. The former is said to turn fuscous when bruised, what my spissa occasionally does; but for the rest the descriptions of A. spissa fit my plants very well, except that of QUÉLET (Flore Mycologique). But Quélet is said (by BOUDIER in Bull. Soc. Myc. Fr. 1902) to have confounded the two species].

10 a. **A. aspera** Quél. (Fr.?).

Spores broadly ovate, $9 \times 6^1/_4\,\mu$.

Fig. specim.: Hjallese, mixed foliaceous wood, Sept. 1897 (and 1900). Very much like the preceding species, but easily distinguished by the at first pale sulphur-yellow universal veil (warts on cap, on edge of ring and at base of stem). The flesh just under the cuticle is also pale yellowish. — While the specimens figured had a pallid grayish-brown cap, I have also met other colour-forms, f. inst.:

Forma *fusca*, with a dark fuscous cap. (Spores 8—$9 \times 7\,\mu$; cells on edge of gills about $18\,\mu$. Lundeborg, wood of Fagus Aug. 1914) and

10 b. var. **Francheti** Boud.

Spores $9 \times 6$—$6^1/_2\,\mu$, cells on edge of gills 20—24 $\mu$ diam. Cap almost whitish, central part slightly yellowish.

Fig. specim.: Hjallese, mixed foliaceous wood, July 1903 (and 1914).

[*A. aspera* (sensu Fries) seems to be the fuscous form mentioned above].

11. **A. rubescens** (Pers.).

Spores oval-ovate, 8—$9 \times 5$—$5^1/_2$.

Fig. specim.: Hjallese, foliaceous wood, Sept. 1897 and Aug. 1900. Very common, as well in foliaceous as coniferous woods, till late in the autumn.

Forma *annulo sulphurea* Gill. = *A. magnifica* Quél. (not Fries). This slender and small form, ring and apex of stem pale yellowish, is met with occasionally in woods of Picea.

[*A. magnifica* Fr. (Fl. Dan. tab. 2146) seems to be only a ringless variety of no. 11].

## II. AMANITOPSIS.

12 a. **A. vaginata** (Bull.).

Spores globular, 9—12 μ diam.

Fig. specim.: Hjallese, wood of Quercus, Aug. 1897. — Very common but rather solitary in foliaceous woods.

There are several colour-forms of this plant: a brown or subfulvous one, which chiefly grows in woods of Betula, a pale gray or livid variety (the one figured), mostly found in woods of Quercus and Corylus, and lastly a small and almost pure white variety:

12 b. **A. vaginata** var. **fungites** Batsch.

Spores $9\frac{1}{2}$—11 × $8\frac{1}{2}$—10 μ, globular.

Fig. specim.: Rudme, outskirts of wood (with the typical form), Sept. 1913.

13. **A. strangulata** Fr.

Spores globular, $10\frac{1}{2}$—13 μ diam.

Fig. specim.: Hjallese, wood of Fagus, solitary. — Rather rare and generally solitary.

This species is not very well distinguished from large and dark brown varieties of no. 12; but typical specimens like the one figured are very conspicuous.

## III. LEPIOTOPSIS.

14. **A. lenticularis** (Lasch). (*A. guttata* Pers.).

Spores almost globular, 5—6 × 5 μ. Basidia 4-spored; Cystidia 0.

Fig. specim.: Fruens Bøge, plantation of Picea, Oct. 1896. — Common (rather late in the autumn) in moist woods of Picea. Very rarely found in foliaceous woods.

[*A. megalodactyla* Berk. appears to be almost identical, to judge from the figure of COOKE (l. cit)].

Additional note.

*A. Persooni* Fr. — On a sandy road-bank, in mixed foliaceous-coniferous wood (Holstenshus June 1898) I found a solitary, very large Amanita, without warts on the cap, which I consider a rather typical A. Personii. But as the spores have not been measured, nor the plant figured, I exclude it from my list.

*A. nitida* Fr. — Rather old specimens of an Amanita, that fairly well corresponded to Fries' description of A. n., were found by me in wood of Fagus, Hjallese, Oct. 1896. Most likely it was only some superannuated specimen of A. Mappa. BOUDIER says A. nitida is nothing more.

# THE GENUS LEPIOTA.

*Lepiota* is a much larger and more heterogeneous genus than *Amanita*, but nevertheless fairly well distinguished from the adjoining genera (*Amanita* and *Armillaria* Fr.). The greatest difficulty is to fix the boundary-line between L. and Armillaria; and I do not think it possible to indicate any characters whichever that can serve to bring about a natural and perfect separation.

As a leading character for the genus *Lepiota* Fries particularly emphazises that the tissue of the stem is distinct from, not concrescent with that of the cap. And this certainly is the case with *L. procera* and its allies; but in many especially of the smaller species (f. inst. L. amianthina) the tissues of cap and stem run absolutely into each other. — Likewise he describes the genus Lepiota as having a universal veil, concrescent with the cuticle of the cap, while the cap of the Armillarias has no veil. This character fits very well when such species as *L. granulosa* and *L. hispida* are kept in view, as here the universal veil forms a peronate, squamulose coating on the stem, which originally is continuous with a similar tissue on the cap. But in *L. rhacodes*, *cristata* a. o. I can see no trace of such a universal veil, the scales on the cap being simply formed by the cracking of the — originally smooth — cuticle itself.

In Lepiota the gills are usually free, often remote; but here again exceptions are found, f. inst. L. amianthina, whose gills are adnate, occasionally even subdecurrent.

Schroeter (l. cit.) lays stress upon the difference in spore-structure and says that in *Lepiota* the spore-membrane is rather firm (the spore consequently of the same form when dry as when soaked in water), while in *Armillaria* the spores have a thin membrane and do not keep their shape when dry. — But

even if we exclude from Armillaria (as he does) *A. mucida* (which has very thick-walled spores), I do not think this character holds good. *L. carcharias* and others have just as thin a spore-membrane as f. inst. *Armillaria bulbigera* or *A. mellea.*

Still, even if no single character can be regarded as absolutely decisive, all the true Lepiotas are characterised by possessing some or most of the above-mentioned characters. Thus the *Proceri* have the distinct cap, the *Granulosi* the universal veil, and so forth.

Some of the *Armillarias* (sensu Fries) have very little in common with the *Lepiotas* (f. inst. *A. bulbigera, A. aurantia* etc.) while others (f. inst. *A. mellea*) run them very close. In fact what is called »the genus Armillaria« is properly speaking no genus at all but a heterogeneous mixture of agarics with white spores and a peronate or annulate stem. And the most satisfactory way of treating this spurious genus will therefore, I think, be to split it up altogether, distributing its several species among the adjoining genera.

To a certain extend this has already been done by the acute French mycologist Quélet. But I think it profitable to carry this principle right through.

I only speak here of the species known to me from personal observation, viz. A. mellea, robusta (and its varieties), aurantia, cingulata, ramentacea, bulbigera, mucida (and corticata).

Of the above named species I think *A. mellea* is a fairly genuine *Lepiota*, characterised by having a universal veil concrescent with the stem and cap. I accordingly include it in the genus Lepiota.

The case for *A. robusta* is not so clear. If the scales and fibrils on the stem up to the ring are traces of a universal veil, it probably should be placed in Lepiota. But by its general habit and its spores it approaches *Tricholoma*, and I therefore — although hesitatingly — refer it to this genus.

To *Tricholoma* certainly must be transferred *A. aurantia*, which — though the stem is peronately scaly — has no ring (only some slight viscid drops in its place). It naturally fits into the tribe *Limacina* of Fries.

*A. cingulata* is simply a *Tricholoma gausapatum* with a distinct ring instead of an arachnoid veil. It consequently goes into the tribe *Genuina.* — *A. ramentacea* (which I have only

seen once, many years ago, and whose spores I do not know) seems to be nearly related to *A. cingulata*.

*A bulbigera* — if the colour of the spores be disregarded — is plainly a *Cortinarius* (Phlegmacium) of the *Scauri*-group. Bulb, gills, arachnoid veil, viscid cuticle etc. are all in the strictest accord with these characteristic agarics. And so, in fact, are the spores, except for their want of colour. But although the colour of the spores is a very important characteristic (and very convenient!), I do not think it right to allow it absolute predomination. There are several instances of coloured and white-spored agarics being most closely related. Thus f. inst. *Naucoria cucumis* has several white-spored allies (*Collybia mimica* etc.), *Mycena galeropsis* is a white-spored *Galera* of the *tener*-tribe, and so forth.

Of course the strict adherence to the classification according to spore-colour — like any other artificial system — has the advantage of uniformity, and facilitates the study for the beginner. But if a deviation from that system helps to bring together species which are really next in kind, it undoubtedly will be a step in the right direction.

*Armillaria mucida* is a rather singular species and has no very near relatives. Still I think it will not be very much wronged if placed next to *Collybia radicata*. It agrees with this species in having large thick-walled spores, a sub-gelatinous surface and broad, firm gills. In fact when C. radicata grows on superficially-running roots — and consequently has no »root« but simply a slight swelling at the base of the stem — it is not unlike the Armillaria mucida, which probably grows on the overhanging branches. — Already FRIES had evidently this similitude in view, when he termed the tribe, for which Arm. mucida is the type: *Collybiæ annulatæ*.

As to *Agaricus corticatus*, which several authors (f. inst. KARSTEN and SCHROETER) refer to *Armillaria*, I follow Fries, who places it in *Pleurotus*. The examination of the spores confirms this view, as they are very much like those of P. ostreatus etc.

That *Armillaria denigrata* (of Fries) is *Pholiota erebia* I think is *in confesso*. And as most likely the rest of the species now included in *Armillaria* will naturally go with one or other of those mentioned above, the whole estate, so to speak, of the

defunct »genus« will have been disposed of and distributed to the heirs which are next in kind.

To recapitulate: The above-named so-called *Armillarias* I classify as follows:

| | |
|---|---|
| *Lepiota* mellea | *Collybia* mucida |
| *Tricholoma* robusta (and its allies) | *Pleurotus* corticatus |
| — aurantia | *Pholiota* erebia. |
| — cingulata | (Armill. denigrata Fr.) |
| — ramentacea. | |

Besides to Armillaria and Amanita the genus Lepiota also affines to some other genera, by some intermediate species:

1) *Pholiota.* — *Ph. aurea*, one of the most magnificent agarics, at once suggests a mammoth *Lepiota amianthina.* It has its peronate stem, its mealy-granular universal veil etc. This has made Quélet place it in *Lepiota* (sub. nom. *L. jurana*) in spite of its yellow spores. [The Pholiota aurea of Fries he erroneously refers to Ph. spectabilis]. Still, as the spores are not at all of the Lepiota amianthina-type, I hesitate to follow Quélet and shall retain it in Pholiota.

2) *Psalliota.* — *Agaricus hæmatospermus* (*echinatus*) is by some authors placed in *Psalliota* (by others, for no good reason, in *Inocybe*). This species Quélet, also refers to *Lepiota*, and I think rightly so. For not only macroscopically, but also microscopically it agrees perfectly with such species of Lepiota as *L. seminuda*, except for the somewhat coloured sporepowder. — *Psalliota cretacea* is to me a rather dubious species. The figures of Fries (Sveriges ätl. sv.) are very much like *Lepiota naucina.* This is also the case with the plant called

3) *Annularia lævis.* Although the sporepowder of this agaric is said to be pink, I think it exceedingly probable that Quélet, Ricken a. o. are right in regarding it as identical with Lep. naucina (pudica), which certainly has white sporepowder, but whose gills are inclined to turn pale pinkish. — The description of Annularia lævis fits my Lepiota naucina like a glove.

Classification. — I do not think it right fundamentally to alter the systematic arrangement of Fries. But the introduction of microscopic characters in the diagnoses not only gives more precision to the determination of the species; it also

makes it possible more definitely to characterise the groups and point out their boundary-lines.

Some of these microscopic characteristics are not altogether »new« characters. F. inst. the nature of the coating on the surface of the cap is — even to the naked eye — very different in such species as *L. amianthina*, *L. acutesquamosa* and *L. clypeolaria*. But by means of the magnifying lens its nature can be more accurately ascertained, it can be seen, whether it consists of globular cells, cylindric cells or filaments etc.

The microscopic characteristics which I have found most useful for classification-purposes in this genus are: 1) the form and size of the spores, 2) the nature of the universal veil (coating on surface of cap), 3) the presence or absence of cystidia (and their form and size). — As far as I have been able to ascertain all the Lepiotas have 4-spored basidia (never 2, as is occasionally the case in some other genera).

*Spores.* — Within this genus the spores vary, I think, more in size and shape than in nearly all other genera, ranging from 3 μ to almost 20 μ in length, from subrotund or ovate to fusiform or almost projectile-shaped. Especially the two latter kinds of spore are particular to this genus. The projectile-shaped spore is met with in quite a number of species, but more or less pronounced. It is characterised by a lateral pedicel and a (somewhat obliquely) truncate base; in extreme cases the basal part, opposite the pedicel, is drawn out into a kind of »heel«, so as to make the entire spore almost angular or bicornute.

The coating on the cap is made up either of globular cells or of filaments. In some cases both forms are found. The surface of the cap will consequently be either mealy, granulate, felty or pilose-squamose.

*Cystidia* are present or wanting in very closely related species; hence this character cannot be used for characterising the principal tribes, but only minor sub-divisions. They vary in outline from subglobular to hair-shaped.

The details of the classification here propounded will be seen in the *Key*. It must however be born in mind — in judging of the merits or demerits of this systematic arrangement — that it only comprizes the species found by me. Thus the group B of Fries (the species with a viscid cuticle) is

not included, as I have not met with any of these. Likewise the species of which *Lep. cepæstipes* is the type do not come within the scope of my list; they probably make up a special tribe.

Setting apart *Lepiota mellea* in a subgenus (*Armillaria*) the genuine *Lepiotas* are divided in three main groups or tribes, according to their macroscopic and microscopic characteristics. For these 3 groups I retain the Friesian names *Proceræ* [1]), *Clypeolariæ* and *Granulosæ*, but in a somewhat extended and altered sense, as *L. naucina* (the only species known to me of the Friesian tribe *Annulosæ*) is transferred to *Proceræ*, *L. acutesquamosa* and its allies cut away from the tribe *Clypeolariæ*, and the species known to me of his fifth tribe, *Mesomorphæ*, placed in a subtribe within the *Granulosæ*.

On the whole the three tribes are very well distinguished, *Proceræ* by the large ovate spores and the free ring, *Clypeolariæ* by their filamentose or hairy-felty coating, and *Granulosæ* by the warty, granular or mealy universal veil, made up (entirely or partly) of subglobular cells.

The point most open to criticism in this systematic arrangement is my placing *L. acutesquamosa* and its allies in the tribe *Granulosæ* (as a special sub-tribe). They are, in fact, exactly intermediate between *Granulosæ* and *Clypeolariæ*, their acute, conical warts being made up partly of subglobose cells, partly of rather filiform hyphæ.

The way in which minor details (form and size of spores etc.) are used in the key for subdividing the tribes will, I think, require no particular explication.

Spores etc. of all the species are figured on Plate II.

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[1]) In accordance with modern usage the orthography is altered from the original Friesian *Proceri* etc.

# KEY

## TO THE SPECIES FIGURED OF THE GENUS *LEPIOTA*.

### I. EU-LEPIOTA.

Gills generally free (rarely somewhat adnate). Terrestrial fungi.

A. **Proceræ** Fr. (sensu aug.). Cuticle of young cap (when in bud) naked, smooth, but often soon cracking. Ring distinct, free. Spores rather large (average length × breadth (in μ) 45 or more), ovate, obtuse, broad (breadth > half the length).

α. macrosporæ. Spores 12 × 7 or more.

a. *squamulosæ*. Cuticle of cap soon cracking into scales; stem scaly or squamulose, base bulbous.

1. Scales dark brown, large . . . . . . . . . . . . . . . . . . *L. procera* (1)
2. Scales ochraceous or pale crust-brown, minute . . *L. umbonata* (2)

b. *lævigatæ*. Cuticle entire (or only somewhat irregularly cracking near the edge), whitish, Stem smooth, almost without bulb . . . . . . . . . . . . . . . . . . . . . . . . . . *L. excoriata* (3)

β. metasporæ. Spores 11 × 6 or less.

a. *squamulosæ*. Cuticle cracking into large scales; stem bulbous.

1. Scales brown . . . . . . . . . . . . . . . . . . . . . . . *L. rhacodes* (4a)
2. Scales whitish . . . . . . . . . . . . . . . *L. rhac. var. puellaris* (4b)

b. *lævigatæ*. Cuticle remaining entire (white); stem almost without bulb . . . . . . . . . . . . . . . . . . . . . . . . . . *L. naucina* (5)

B. **Clypeolariæ** Fr. (sensu alt.). Surface of stem and young cap more or less covered with a fibrillous or floccose universal veil (rarely almost glabrous). Cuticle cracking or entire. Ring generally inferior or fugacious. Spores either small or large, but then somewhat pointed and narrow (breadth ≦ half the length).

α. fusisporæ. Spores large, ellipsoid or fusiform, 9—18 μ long.

a. *squamulosæ*. Surface of cap broken up into innate squamules.

1. Scales blackish or bistre. Spores ellipsoid, 9—11 μ long . *L. felina* (6)
2. Scales brownish or pale. Spores fusiform, 12—18 μ long.
   - * Cap. 4—8 cm; umbo almost smooth . . . . . . *L. clypeolaria* (7)
   - ** Cap. 2—4 cm; umbo with minute, erect, pointed squamules . . . . . . . . . . . . . . . *L. clyp. var. metulispora* (8)

b. *lævigatæ.* Surface of cap remaining entire.
1. Cap gilvous (edge pale). Spores fusiformely ellipsoid *L. gracilis var.* (9)
2. Cap whitish. Spores broadly ellipsoid . . . . . . . . *L. erminea* (10)
— [cnf. also *L. Meleagris* (No. 11)]. —

β. stenosporæ. Spores rather small (rarely over 9 μ long), narrow, more or less projectile-shaped (ɔ: base somewhat truncate with a lateral pedicel).
a. *squamulosæ.* Surface of cap breaking up into small innate squamules.
1. Scales very pale crust-brown or ochraceous. Partial veil cobweb-like . . . . . . . . . . . . . . . . . . . . . . *L. Cortinarius* (12)
2. Scales reddish or dark brown. Partial veil not arachnoid.
* Stem floccosely squamulose (spores 9—11 μ) . . *L. castanea* (13)
** Stem almost glabrous, sligthly silky-fibrillous (spores 7 μ) *L. cristata* (14)
b. *lævigatæ.* Surface of cap entire.
1. Cap gilvous (with indistinct, adpressed scales) *L. helveola var.* (15)
2. Cap white, smooth or slightly silky-fibrillous . *L. albo-sericea* (16)

γ. brevisporæ. Spores small (7 μ or less long), broad (breadth $\geqq$ half the length).
a. Stem squamulose. (Young cap pale brownish, minutely piloso-squamulose, especially in the middle; cuticle soon cracking.) *L. Forquignoni* (17)
b. Stem glabrous.
1. Cap slightly cracked, reddish . . . . . . . . . . . . . . *L. Morieri* (18)
2. Cuticle breaking up into small, blackish, innate squamules *L. micropholis* (19)

C. **Granulosæ** Fr. (sensu aug.)
Surface of young cap (and generally also the stem) covered with either conical, erect scales, granular warts or mealy powder, which coating wholly or partly is made up of globular cells. Spores small (not over 8 μ long).

α. acutesquamosæ. Surface of young cap (at least the central part) set with pointed, erect conical (somewhat deciduous) scales.
a. Gills forked; spores projectile-shaped; cap large (7—14 cm) *L. acutesquamosa* (20)
b. Gills not forked; spores very small, oval.
1. Cap 4—6 cm broad . . . . . . . . . . . . . . . . . . . . *L. hispida* (21)
2. Cap about 2 cm. . . . . . . . . . . . . . . . . . . . . . *L. echinella* (22)

β. granulatæ. Surface of cap and stem granulate. Stem peronate. (Spores oval or ovate).
a. Cystidia present, hair-shaped. Cap red or brown.
1. Cap bright red. Stem stout, subbulbous. . . . *L. cinnabarina* (23)
2. Cap brown. Stem more slender . . . . . . . . . . *L. granulosa* (24)
b. Cystidia absent. Cap yellowish or whitish.
1. Cap ochraceous-yellow. Spores 6—7 μ long . . *L. amianthina* (25)
2. Cap pinkish-white. Spores 5 μ long . . . . . . . . *L. Carcharias* (26)

γ. seminudæ. Surface of cap mealy. Stem not distinctly peronate, mealy or subglabrous.
  a. Spores projectile-shaped (7 μ long). Stem (and cap) more or less violet . . . . . . . . . . . . . . . . . . . . . . . . . *L. Bucknalli* (27)
  b. Spores ovate, less than 6 μ long.
    1. Spores pure white; gills white.
      * Cap with a somewhat pinkish tint, 1—2 cm . *L. seminuda* (28)
      ** Cap pure white, about 1 cm . *L. semin. var. parvannulata* (29)
    2. Spores pale smoke-gray with a slight pinkish tint; gills red. Cap mouse-gray . . . . . . . . . . . . . . *L. hœmatosperma* (30)

## II. ARMILLARIA.

Gills somewhat decurrent. Fungi growing on and around stumps etc. (not truly terrestrial). Cap pilose-scaly; scales when young often somewhat yellowish, soon turning fuscous . . . . . . . . . . . *L. mellea* (31)

# SYSTEMATIC AND FLORISTIC NOTES ON THE SPECIES.

## I. EU-LEPIOTA.

### A. PROCERÆ.

#### α. MACROSPORÆ.

1. **L. procera** (Scop.).

Spores 14—18 × 9—11 μ (or 12—16 × 8½— 10 μ).

Fig. specimens: Hæsbjerg, grassy slope, open space in wood of Fagus, Oct. 1899. — Not very common, generally solitary, in open spaces in or just outside foliaceous woods.

2. **L. umbonata** (Schum.) (forma *major*). (? *L. dolichaula* B. et Br.).

Spores oval, 12—16½ × 7½—9½ μ.

Fig. specim.: Slipshavn near Nyborg, open space outside foliaceous wood, Sept. 1905. — Not common, in grassy places in coniferous and foliaceous woods, on hill-slopes etc.

Of the various names for slender and umbonate fungi of the *proceræ*-type, I have chosen the above, proposed by the eminent Danish mycologist (Enumeratio plantarum Sælland., 1801—03). My plant is however somewhat larger than he figures it. *L. dolichaula* B. et Br. (from India) appears to be exactly identical with my plant, but there is hardly a specific difference between L. d. and L. umb. — Several other intermediate forms seem to connect it with L. procera, f. inst. *L. prominens* Fr. and *L. permixta* Barla from Southern France, and *L. gracilenta* Krombh. — The leading characters of my plant are: the rather acute umbo, the pallid ochraceous or pale crust-brown cap, the thin cuticle of which is minutely granulate-squamulose, and the ring, which is smaller than in L. procera, but equally persistent. The stem is whitish, very minutely squamulose.

3. **L. excoriata** (Schaeff.).

Spores oval, 12—16 × 8—10 μ. — Cystidia obtusely fusiform, 50 × 10 μ (1914).

Fig. specim.: Torning near Silkeborg, sandy stubble-field, Sept. 1897. — Rather common, in grass- and cornfields on light and sandy ground, often very numerous.

This is one of the few of the larger agarics, which grow on cultivated land. Occasionally the cap is more prominently umbonate than shown in my figure, thus to a certain extent recalling the *L. umbonata*-type.

### β. METASPORÆ.

4 a. **L. rhacodes** (Vit.).

Spores ovate-ellipsoid, $8^1/_2$—$10 \times 6$ μ (or $9$—$11 \times 6$).

Fig. specim.: Fruens Bøge, plantation of Picea, Oct. 1896. — Very common, often rather numerous, especially in woods of Picea, rarely found in foliaceous woods, under hedges etc. — Blytt (Norges Hymenomyc.) makes it a subspecies of L. procera; but this view I cannot share. — Massee (Europ. Fungus-Flora) erroneously gives the dimension of the spores as $14 \times 8$ μ and says the flesh turns brown (not red).

4 b. **L. rhacodes** var. **puellaris** Fr.

Spores $8$—$9 \times 5$—$5^1/_2$ μ, oval. Cystidia (1914) obovate—bottle-shaped, about 16 μ broad, occasionally with a somewhat protruding apex.

Fig. specim.: Gerup near Holstenshus, wood of Picea, Aug. 1902. — Rarer than the main type, smaller, almost pure white, flesh not turning saffron-red. Although this is a very characteristic plant, its total separation from L. rhacodes cannot be justified, as there are numerous intermediate forms. *L. Olivieri* Barla appears to be such a one.

5. **L. naucina** Fr. (*Ag. lævis* Krombh.).

Spores broadly ovate, $8$—$9^1/_2 \times 5^1/_4$—$5^1/_2$ μ, with a large central drop. When seen under the microscope they have a very slight pinkish tint, but the sporepowder is white. — Cystidia about 55 μ long, 10—11 μ broad, club-shaped; basidia 4-spored.

Fig. specim.: Hjallese, on lawn, border of flowerbed, Aug. 1902. — Rather rare and often solitary in gardens, under hedges (and once in a wood of Picea), Aug.—Oct.

The cap is smooth, either absolutely glabrous or (sub lente) minutely fibrillose-floccose. The gills are white, but generally turn somewhat pinkish. The ring is very narrow, free (at least in mature specimens).

The best and fullest description of this plant (which is the bearer of almost a legion of names) is given by the American botanist Atkinson (Studies and Illustrations of Mushrooms). The description of *Annularia lævis* fits my plants exactly (except that the spores are said to be pinkish); and with Quélet, Ricken and others I regard it as synonymous. That also *L. densifolia* Gill. *L. pudica* Bull., *L. Schulzeri* Kalkbr., *L. leucothites* Vit. etc. are identical seems to me highly probable. The *Psalliota cretacea* figured in Fries' »Ätliga och giftiga Svampar« is also very much like my plant.

## B. CLYPEOLARIÆ.

### α. FUSISPORÆ.

6. **L. felina** (Pers.).

Spores ellipsoid, 9—11 × 5—$5^1/_4$ μ.

Fig. specim.: Aalykkeskov near Odense, on humous ground in foliaceous wood, Aug. 1902. — Also in garden-bed, Allerup, Aug. 1907, and in moist copsewood near Egeskov 1914. — Rare and solitary.

Distinguished from the following species by its small cap (2—3 cm) with almost black scales, and by the shorter, almost ellipsoid spores.

7. **L. clypeolaria** (Bull.).

Spores almost fusiform, somewhat oblique, 13—18 × 4—5 μ. (1914: 15—19 × 5—$5^1/_2$ μ, edge of gills sparingly set with inflated sack-shaped, 10—20 μ broad cells.)

Fig. specim.: I. Hæsbjerg, foliaceous wood, Oct. 1897. II. Pederstrup, wood of Picea, Oct. 1899. — Common, but often solitary, in coniferous and foliaceous woods till late in the autumn.

This species varies a good deal in colour. An extreme colour-form is

*L. clyp. forma albida.* — Spores 13—16 μ long. Cap and stem whitish. — Hæsbjerg, wood of Fagus, Sept. 1905.

8. L. (*clypeolaria* var.) **metulispora** B. et Br.

Spores ellipsoid-fusiform, $13^1/_2$—15 × $5^1/_2$—6 μ. Basidia 4-spored, broadly club-shaped; Cystidia small, inconspicuous, ovate-fusiform or somewhat bottle-shaped.

Fig. specim.: Hollufgaard, solitary under Æsculus, in wood of Fagus, Oct. 1914.

This plant is very intimately related to the preceeding and hardly to be considered a distinct species. But it is easily distinguished, being in fact, macroscopically more like slender specimens of *L. Forquignoni.* — The cap is very pale ochraceous, about $2^1/_2$ cm broad, the central part set with minute, erect, pointed squamules (formed of agglutinated hairs). The stem is almost naked and turns yellow inside and outside when bruised.

[The umbo of *L. clypeolaria* is generally described as being glabrous, and if so the two species would be clearly distinct. But when young true clypeolarias — at least in some cases — have the umbo somewhat felty-pilose, thus approaching L. metulispora. — Massee (loc. cit.) gives the correct measure for the spores of L. metulispora, but attributes to L. clypeolaria very minute spores (6 × 4 μ).]

9. **L. gracilis** Quél. var. nov. **lævigata**. (Plate I, fig. a).

Spores ellipsoid-fusiform, $11^1/_2$—$13^1/_2$ × $4^1/_2$ μ.

Fig. specim.: Vosemose, Sept. 1905, a number of specimens on grassy roadside-bank.

The plants collected by me differ from the description of L. gracilis in having an entire, not minutely cracked cuticle. As my variety may possibly be a distinct species, I add a brief description:

Cap $1^1/_2$—$2^1/_2$ cm broad, at first convex, then expanded, somewhat umbonate, glabrous, towards the edge minutely fibrillose-floccose (when seen under a lens), central part fulvous-ochraceous or gilvous, edge pale. Veil fugacious, mostly attached to edge of cap. Stem about 3 cm × 3 mm, below the veil sparingly covered with cottony, floccose scales. Gills white, with a slight gilvous tint, free, rather crowded. Odour faint, sweetish. —

While L. gracilis Quél. seems to be very much like L. metulispora, my plant cannot be confounded with it (or with any other small form of the *clypeolaria*-tribe).

10. **L. erminea** Fr.

Spores ovate-ellipsoid, 11—14 × $5^1/_2$—6 μ. Basidia 4-spored.

Fig. specim.: »Haare Bjerge«, near Gelsted, grassy banks outside a coniferous wood, Oct. 1907. — Also on grassy banks outside a wood of Pinus, Strib, Sept. 1909.

The white cap is at first smooth (sub lente slightly and minutely flocculose), later on somewhat silky-filamentose. The stem is at first cottony floccose, then glabrous.

11. **L. Meleagris** Sow.

[Odense, growing somewhat cæspitosely on tanners bark in greenhouse (hot stove), July 1903. — not figured.

I have not had the opportunity to measure the spores of this characteristic species, but as they are said to be ellipsoid, 8—11 μ long, it probably belongs to this group. — My specimens had a cap of 4—5 cm diam., a rather slender stem (8—10 cm), both cap and stem with dark red-brown squamules and becoming reddish when touched or bruised. — As tanners bark is nowadays very rarely used in greenhouses, this fungus undoubtedly has become exceedingly rare].

β. STENOSPORÆ.

12. **L. Cortinarius** n. sp. (Plate I, fig. b).

Spores oblong-ellipsoid, somewhat projectile-shaped (with obliquely truncate base and lateral pedicel), 8 × $3^1/_4$ μ. Cystidia obovate, about 10 μ broad.

Fig. specim.: »Skelmose« near Hesselager, wood of Abies, a number of specimens growing dispersedly on the ground among the dead foliage, Oct. 1909.

Cap $5^1/_2$—$7^1/_2$ cm, fleshy, at first somewhat campanulate, then expanded, gibbous; cuticle pale crust-brown, soon cracked into minute squamules. Veil very fugacious, only represented by cobweb-like filaments, extending from the stem to the edge

of the cap, which at first is incurved, overreaching the gills. Stem 6—7 cm long, about 1 cm thick, attenuated from the about 2 cm broad subbulbous base, minutely fibrillose (base sparingly set with floccose scales), whitish, with a slight tinge of pale brown, cavity filled with arachnoid filaments. The tissue of the stem is distinct from the cap, and a very narrow collarium separates the gills from the apex of the stem. Gills lanceolate, crowded, whitish, later on slightly flushed with a gilvous tint. Odour faint, not unpleasant.

This species seems to be somewhat related to *L. Boudieri*, but differs from almost all other Lepiotas by its ringless stem and arachnoid veil.

13. **L. castanea** Quél.

Of this species I have met with two forms:

I. Spores projectile-shaped (occasionally almost bicornute), $9—11^1/_2 \times 3^3/_4—4^1/_2$ μ. Cystidia hair-shaped (rather broad and obtuse).

Fig. specim.: Hæsbjerg, on the ground under Picea, rather numerous, Oct. 1898. (Also found in similar locality, Aalsbo Bakker 1899). In this form the gills turn bright brownish-red with age, especially towards the edge (transition to L. Boudieri). The cuticle of the young, unexpanded cap is almost glabrous.

II. Spores of the same shape, but a little larger ($10—13 \times 4—5$ μ). In this form (not figured) the gills do not turn red (although the flesh does), and the cap is originally somewhat felty. It is met with occasionally in as well foliaceous as coniferous woods, but can hardly be considered a distinct species.

14. **L. cristata** (Alb. et Schw.).

Spores projectile-shaped, $6—7^1/_2 \times 3$ μ. Cystidia inflated obovate, crowded, 12—16 μ broad.

Fig. specim.: Hjallese, roadside-bank, outskirts of copsewood, Oct. 1898. — Common, but rather sporadic, in gardens, woods and other shady localities.

[Schroeter (l. cit.) says L. cristata has hair-shaped cystidia. I have met — but only once — a single specimen with cystidia of that type. Macroscopically it could not be distinguished from the ordinary L. cristata]. Conf. also no: 18.

15. **L. helveola** Bres. *var.* (?) (Plate I, fig. c.)

Spores projectile-shaped, $7^1/_2—8 \times 3$ μ.

Fig. specim.: Lundsgaard Storskov, on the ground in moist wood of Fagus, a few specimens, Sept. 1905.

Cap 2—4 cm, convex-expanded, slightly umbonate, surface sparingly covered with adpressed, fibrillous scales (not cracked-granulate), gilvous or somewhat orange, umbo slightly darker (subfulvous) and almost without scales, edge paler. Stem slender (about

6 cm × 3—4 mm), below the fugacious veil sparingly clad with fibrillous squamules of the same colour as the cap. Cavity of stem filled with fibrillous down. Gills free, white with a slight yellowish tinge.

From the typical *L. helveola* it differs in having smaller spores. Not unlikely it is the variety *Barlæ* Bres., mentioned in »Fungi Tridentini«, vol. II, but I have not seen the figure. — The plant described by Quélet (l. cit.) as *L. helveola* seems to be *L. Forquignoni*.

16. **L. albo-sericea** P. Henn.

Spores projectile-shaped, 9 × 4½ μ. Cystidia hair-shaped, about 5 μ broad. Basidia 4-spored.

Fig. specim.: »Fjellebro«. On leaf-mouldy ground under Æsculus in park, Sept. 1909.

Cap 1½—2½ cm, campanulate, then expanded-gibbous, white, centre with a slight tinge of brownish, at first smooth, then slightly silky-fibrillous and adpressedly squamulose, edge at last somewhat grooved. Stem about 4 cm × 2—3 mm (base slightly bulbous), white, then somewhat brownish-red (especially the base and the inside), below the ring slightly cottony squamulose-tomentose. Ring white, membranaceous, soon split, mostly attached to the edge. Gills free, but not remote, cream-white, rather crowded. Odour faint and not so disagreable as in L. cristata.

I refer this plant to *L. albo-sericea* P. Henn.; but most likely several other (and older) names are synonyms. Thus the bigger form of *L. parvannulata* (which is said to have a hairy-silky cap) may be identical, and the same, not unlikely, is the case with *L. serena* Fr.

γ. BREVISPORÆ.

17. **L. Forquignoni** Quél. (Plate I, fig. d.)

Spores oval or ovate, 6—7 × 3½—4 μ. (1914: Cystidia obtusely fusiform, about 30 × 7—8 μ).

Fig. specim.: Vormark Mølleskov, a few specimens among sticks and foliage, in wood of Picea, Oct. 1900. — Rather rare, in coniferous woods.

The cap varies somewhat in colour, being in some cases more fulvo-ochraceous. The gills are sometimes very broad. Slender and ochraceous forms may be mistaken for L. metulispora (if the spores be not examined). Both species are characterised by the minute, pointed, erect squamules in the middle of the cap, formed by somewhat agglutinated hairs. It has a very faint sweetish odour.

18. **L. Morieri** Gill. (?)

Spores oval, 5½ × 2¾ μ. Cystidia obovate, about 10 μ broad.

Fig. specim.: Tarup near Odense, on lawn in old shady garden, solitary, Aug. 1897.

Very closely related to L. cristata, from which it only differs by the shorter, more oval spores and the smaller cap with a paler and but slightly cracked cuticle. As I have never seen it since 1897, I cannot decide whether my plant is anything but a mere form of *L. cristata*.

19. **L. micropholis** B. et Br.

Spores ovate, $4—5 \times 2^3/_4—3^1/_4$ μ. Cystidia club-shaped, apex 7—8 μ broad. Scales on cap made up of grayish cells, inflated in one end.

Fig. specim.: Copenhagen, Botanical garden, in flowerpot in subtropical house, April 1908.

Evidently an introduced species. It has the smell of L. cristata.

## C. GRANULOSÆ.

### α. ACUTESQUAMOSÆ.

20. **L. acutesquamosa** (Weinm.).

Spores cylindric-ellipsoid, obliquely pedicellate, $7—8 \times 2^1/_2—3$ μ (1900); $7^1/_2—8 \times 2^3/_4—3$ μ; cystidia obovate-subrotund (1902, fig.).

Fig. specim.: Hollufgaard, moist copsewood (Fraxinus and Alnus), on the ground, Sept. 1902. — Not uncommon in moist foliaceous woods, but rather sporadic and not every year. —

Although this plant is one of the most characteristic of the whole Agaric tribe, it seems to be very disputed by the authors and often unsatisfactorily described. Thus Fries evidently confounds some of the characters of this species and of *L. Friesii* (which latter he has not seen alive), attributing to the former the pointed scales, to the latter the branched gills. The fact is that in *L. acutesquamosa* the cap (even when in bud) is densely set with erect, pointed, hard, somewhat deciduous warts, and the gills repeatedly forked. By means of these characters it can be easily distinguished from its allies. Quélet (l. cit.) describes it very well under the name of *L. aspera* (under which name he also includes *L. Friesii*). If he be right in this, the Friesian description of *L. Friesii* may refer to large specimens of *L. acutesquamosa* which have lost their warts.

21. **L. hispida** (Lasch). (? *L. fusco-squamea* Peck) (Plate I, fig. e).

Spores oval, $5—6 \times 2^3/_4—3$ μ, with a small, oblique pedicel. Basidia 4-spored. Cystidia 0.

Fig. specim.: Marselisborg Skov near Aarhus, on naked, black soil in a bog, under Fraxinus etc., a number of specimens, Oct. 1914; (first found by P. Larsen).

This agaric looks very much like a small L. acutesquamosa (cap 4—6 cm broad), but is easily distinguished by the undivided

gills, the shorter, oval spores etc. The stem is peronate, densely clad with recurved, coarse, dark brown scales from base to ring.

The figure in Fries: »Icones sel.« does not show the acute, erect, pyramidal scales on the cap (and the bud is shown quite smooth); nor are they mentioned in his description. Quélet mentions the scales, but his description is in other respects defective. The best description is that of Peck (*L. fusco-squamea*, Sacc. Syll. V); but as I think there can be little doubt of its identity with L. hisp., I retain the older name. — The fungus described by Ricken (l. cit.) as L. hispida seems to me more like a form of L. acutesquamosa.

22. **L. echinella** Quél. (Plate I, fig. f.).

Spores broadly oval, 4—5 × $2^1/_2$—$2^3/_4$ μ. Cystidia 0. Basidia 4-spored.

Fig. specim.: I. Vormark, in wood of Picea and Sambucus, on the ground among sticks and foliage, Sept. 1902. II. Hunderup, moist ground in foliaceous wood, Sept. 1903. — Rare and solitary.

This plant is very closely related to the preceding species, the darker form (II) being in fact altogether a miniature of it. The spores are somewhat shorter, the cap rarely exceeds 2 cm in diameter.

When in bud the 3 last species with their brown, mucronate scales somewhat resemble Lycoperdon echinatum.

## β. GRANULATÆ.

23. **L. cinnabarina** Fr.

Spores oval, $4^1/_2$ × $2^1/_2$—$2^3/_4$ μ. Basidia 4-spored. Cystidia hair-shaped, acute (1910).

Fig. specim.: Grib Skov (foliaceous-coniferous wood), Sept. 1896. (Also found at Frederikshaab, near Naarup, in wood of Fagus, Aug. 1910).

My plants come very near to Cooke's figure of *L. Terrei*; but I do not see any notable difference between this one and L. cinnabarina proper.

24. **L. granulosa** (Batsch.).

Spores oval, 4—5 × $2^1/_2$—3 μ (fig.). — 1914: Spores 4 × $2^3/_4$ μ. Cystidia hair-shaped, acute, small, 2—3 μ broad. Cells on surface of cap subglobular, mixed with others which are almost cylindric, irregularly bent or wavy.

Fig. specim.: Trolleborg, mossy roadside in coniferous plantation, Oct. 1899. — Not common, chiefly in open spaces on sandy soil, in or outside plantations of coniferous trees. — Very closely related to no: 23. It is often considerably smaller than the specimens figured.

25. **L. amianthina** (Scop.).

Spores oval, $6—7 \times 3^1/_2$ μ. — 1914: $6—6^1/_2 \times 3^3/_4—4$ μ. Cystidia 0. Basidia 4-spored. Cells on surface of cap globular or balloon-shaped, 15—18 μ diam.

Fig. specim.: Hæsbjerg, mossy spaces in wood of Picea, Oct. 1897. — Found everywhere in mossy coniferous woods.

The want of cystidia and the longer spores distinguish this species very clearly from the two preceding ones.

26. **L. Carcharias** (Pers.).

Spores $4^1/_2—5 \times 3$ μ. — 1914: Spores subrotund-oval, $5—5^1/_4 \times 3^2/_3—4$ μ. Cystidia 0.

Fig. specim.: I. Aarup, wood of Picea, Oct. 1896. II. Hæsbjerg, wood of Picea, Oct. 1897. — Common in coniferous woods.

γ. SEMINUDÆ.

27. **L. Bucknalli** B. et Br.

Spores $7 \times 3$ μ (fig.). — 1914: Spores projectile-shaped, $7—8 \times 3$ μ. Cystidia 0. Mealy coating on cap made up of globular cells, 20—45 μ diam.

Fig. specim.: Nyraad, wood of Fagus, moist mouldy soil, Oct. 1900. — Also found on boggy ground in wood (of Fraxinus etc.), Marselisborg near Aarhus, Oct. 1914 (together with L. hispida and L. hæmatosperma).

28. **L. seminuda** Fr.

Spores ellipsoid-oval, $4 \times 2^1/_2$ μ.

Fig. specim.: Flødstrup, wood of Fagus, on the ground among dead foliage.

Not common, but found as well in coniferous as in foliaceous woods. — Odour very faint.

29. **L.** (*seminuda* var.) **parvannulata** Fr. (forma *minima* Fr.).

Spores $3^1/_2—4 \times 2$ μ. Basidia 4-spored. Cystidia 0. Cells on surface of cap 20—30 μ diam.

Fig. specim.: Aalykkeskov near Odense, on leaf-mouldy ground in copsewood, Aug. 1912. Rather rare.

Smaller than no. 28; cap almost pure white, umbo slightly fleshy. When examined under a lens the surface of the cap is seen to be very thinly covered with mealy particles (globular cells).

The larger form of L. p., which is described by Fries as having a »silky« cap and fibrillous stem, seems to be very closely related to (or identical with) *L. albo-sericea* P. Henn. (no. 16).

30 a. **L. hæmatosperma** (Bull.). (*Ag. echinatus* Roth, *A. fumoso-purpureus* Lasch.).

Spores $4^1/_2$—$5^1/_2 \times 2^1/_2$—3 μ, oval, hyaline with a slight brownish tint. (1914: spores $5$—$5^1/_2 \times 3$—$3^1/_4$ μ). Cystidia 0. Surface of cap densely covered with a mealy-floccose coating of globose cells (diam. 18—30 μ).

Fig. specim.: Kajberg Skov near Nyborg, on heap of leaf-mould, July 1910. — Rather rare and generally solitary, on rich humus in shady places. The whole plant has a faint but characteristic smell, not unlike that of L. cristata, but more sweetish-aromatic.

30 b. **L. h.** forma *gracilis* Quél.

Spores ovate-ellipsoid, $5 \times 2^3/_4$ μ. Basidia 4-spored. Cells on cap 25—50 μ diam.

Fig. specim.: Hjallese, solitary in flower-bed, Oct. 1898.

Smaller and without traces of a ring (veil reduced to a fibrillose-floccose edging on the cap).

This very characteristic little agaric has been placed by some authors in *Psalliota*, by others in *Lepiota*, *Inocybe*, *Naucoria*. The sporepowder is neither brown nor Psalliota-coloured, but very pale fuscous with a slight tinge of pink. (According to Poul Larsen this pinkish tint is wanting when the spores have not been exposed to daylight, but appears almost instantly when exposed).

Quélet and other authors call this fungus *Ag. echinatus* Roth; but as Bulliard's name is older (and better), I prefer to use it. — Quélet's *L. hæmatosperma* is *L. Badhami* (vide Quélet et Bataille: Flore monographique). Sev. Petersen (l. cit.) erroneously describes the same plant twice (as Psal. echinata and hæmatosperma).

## II. ARMILLARIA.

31. **L. mellea** (Vahl in Fl. D.) J. E. L.

Spores roundish-ovate, $7^1/_2$ – $8^1/_2 \times 5^1/_2$—$6^1/_2$ μ (1900) or 8—9 × 6—7 μ.

Fig. specim.: Hjallese, on decayed stump of foliaceous tree, Oct. 1894. — Exceedingly common on and around trees and stumps, solitary or densely cæspitose.

# THE GENUS COPRINUS.

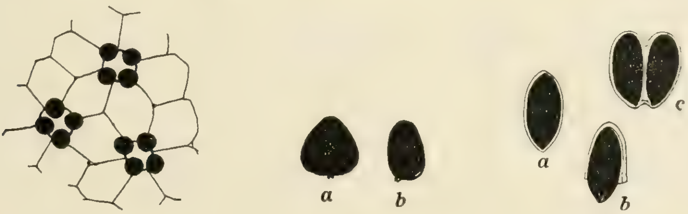
As indicated by the popular names »Blækhat«, »Tintling«, »inkcap« etc. the outward appearance of the Coprini differs very markedly from the ordinary mushroom-type, and Coprinus was recognized by PERSOON and FRIES as a distinct genus long before the subgenera of Agaricus were raised to generic rank. Still the Coprini are not absolutely separated from the genuine agarics: *Bolbitius* (which may be regarded as merely a subgenus of Coprinus) naturally leads into *Pluteolus* and the *Galeras* of the *tener*-tribe. And the exotic genus *Hiatula* as well as the *Psatyrellas*, each in their way, show certain affinities. In fact considerable divergence exists as to where to draw the boundary-line between Psatyrella and Coprinus. Thus *Agaricus disseminatus* and *impatiens*, which FRIES ranged in Psatyrella, QUÉLET considers (justly, I think) true Coprini, while other modern authors retain them in Psatyrella.

Although the most characteristic feature of the Coprini is the deliquescence of the gills, the microscopic characters are of greater importance for the exact limitation of the genus. Many of the smaller Coprini hardly do liquify, but all species present the gill-structure peculiar to this genus. When examined by low power the surface of a Coprinus-gill looks somewhat like fig. I., the fertile basidia being separated by larger, sterile cells (»paraphyses«), (conf. SCHROETER, loc. cit. pag. 517). — This structural characteristic seems to be a reliable means to trace the line of demarcation between *Coprinus* and *Psatyrella*, although the line will have to be drawn a little otherwise than originally done by FRIES, as *Psatyrella disseminata* and *impatiens* show the gill-structure of Coprinus. But as these species are also in other respects decidedly coprinoid (f. inst. in having borst-like cystidia on the surface of the cap like Copr. ephemerus etc.),

I deem their transference to Coprinus a decided systematic improvement.

Other microscopic features are of importance for the determination and classification of the several species:

S p o r e-c o l o u r. — While the rusty-spored *Coprini* are generally set apart in a special genus, *Bolbitius*, the attempt to single out the species with snuff-brown sporepowder as a special genus or subgenus (*Coprinopsis* Karst.) has not met with general approval. In fact all shades from pitch-black to brown are represented, and it is consequently almost impossible to draw a clear boundary-line. The same may be said of the colour of the individual spore (sub microsc.). It varies from pale date-brown transparency to almost pure coal-blackness. The colour of the (ripe) spore




I. II. III.

I. Surface of *Coprinus*-gill. — II. Spores of *C. plicatilis*. 750 : 1. — III. Spores of *C. narcoticus*. 750 : 1.

seems to be very constant and consequently is a good specific character, even if it cannot be used with profit for subdividing the genus.

The o u t l i n e and s i z e of the spores vary considerably within the genus. The spores of the Coprini are generally rather large; spores less than $8 \times 5\,\mu$ are rare; in most species the average length is $10$—$13\,\mu$, but some few species have almost gigantic spores, especially *C. sterquilinus*, whose spores average $19 \times 12\,\mu$. — In most cases the outline of the spore is oval or subovate, but some species have lemon-shaped or subcordate (triangular-subrotund) spores. These latter have a wart-like apex and a somewhat truncate base and are (always?) somewhat flattened, thus showing a different outline when viewed from the side or the front (fig. II). This may lead the uncautious observer to the erroneous conclusion that the spores are biform. In all the species observed the spore-membrane is smooth; granulate spores like those figured by Ricken (Coprinus

tergiversans Fr.) I have never met. [Most spores have however only been examined by moderate power (Seibert Obj. IV, focal distance 6,4 mm.)].

In some cases the spores are provided with a double membrane, an almost hyaline epispore enclosing the spore itself. This was noted by EMIL CHR. HANSEN (Bot. Zeitung 1897, VII) for *C. stercorarius*, and is still more easily perceptible in *C. narcoticus.* In this latter species I have even met with twin-spores ɔ: two spores enclosed in one episporal membrane (fig. III). This singular monstrosity seems however to be rather exceptional (1914: less than one pr. mille, 1915: about 2 pr. C. of the spores of my specimens).

The cystidia of the Coprini are generally vesicular, either subglobate, ovate or somehwat flask-shaped. A particular form of cystidia are found in some few species (f. inst. *C. ephemerus, tardus* and *disseminatus*) on the surface of the cap, in the shape of minute, erect setulæ, just discernible under an ordinary lens.

For purposes of classification the nature of the surface of the cap seems to me of supreme importance. Already FRIES laid great stress upon this feature and made it the leading character of his subdivisions of the genus. Unfortunately his two main tribes (»*Pelliculosi*« and »*Veliformes*«) were based on another, far less valuable character: the fleshy or membranaceous nature of the cap. (Especially for the coprobious species fleshiness is a particularly unreliable character, as they vary exceedingly in size according to circumstances). And being restricted to macroscopic investigations, FRIES occasionally would be apt to misplace a species by not properly discerning the nature of the surface-coating. For such reasons we find in »Hymenomycetes Eur.« the mealy-floccose *C. stercorarius* and *C. narcoticus* (which are absolutely next in kind) separated, and grouped respectively with the glabrous *C. plicatilis* and the pilose *C. lagopus*, with which they have nothing to do. And *C. lagopus* again is widely separated from *C. tomentosus,* althougt they are almost identical. Unfortunately most later authors have repeated or even aggravated such errors.

By discarding the fleshiness of the cap as leading character and basing the main divisions on the absence or presence of a universal veil, and the microscopic structure of the same, a more natural classification can be attained, without deviating fundamentally from the systematic arrangement of FRIES.

In most Coprini the young cap is covered by a coating (a universal veil). But this coating is either made up of filaments, which form a felty or pilose covering, or of loose, globular cells (in which case it will be mealy or granular). A number of species, especially smaller ones, are entirely devoid of universal veil, the cap being consequently absolutely naked. The genus thus naturally falls in three main groups or tribes, which I term *comati*, *farinosi* and *nudi*.

The details of the classification can be gathered from the Key (see over) and require no particular explanation.

As indicated by the name *Coprinus* the genus is largely coprophile. Of the 56 species in Fries' Hymenomycetes 17 (or about $^1/_3$) are said to grow on dung or manured soil. Of the 169 species recorded by Massee (Annals of Botany, X.), about $^1/_4$ are said to be coprophile. — Strange to say »Fungi fimicoli danici« by E. Chr. Hansen (1876) only mentiones 5 (or 6) dung-loving species as found in Denmark. The number seems to be at least 13. Of the 32 species noted by me at least 12 are coprophile. — The xylophile species are comparatively few, and it is not always easy to make out whether a species is really wood-loving or not. Thus f. inst. C. domesticus grows occasionally on decaying wood (rotten timber etc.), but is also to be met with growing on the ground in woods. And C. micaceus, which generally grows around trunks, is not unfrequently met with growing apparently as a parasite on living trees.

The total number of my Danish Coprini is 32 (or 30, if the Friesian limitation of the genus be adhered to). This is about $^3/_4$ of the number of Swedish species mentioned in »Hymenomyc. Europ.«; but since the time of Fries the number of known species of Coprinus has been very much augmented — even if the enormous number mentioned by Massee (loc. cit.) comprises a considerable number of synonyms, as in all probability it does.

Like other, especially coprophile, fungi some of the Coprini are almost cosmopolitan. One (C. curtus) is in fact only recorded from South Africa and Denmark. This world-wide distribution together with the ephemeral nature of many species goes a long way to explain the large number of synonyms, as the same plant, when gathered in different parts of the globe, will often be awarded different names and recorded as a number of »new

species«, especially as the Coprini are even worse than the ordinary agarics to bring safely home for study and to preserve.

Their rapid developement and decay has also been a great obstacle to my figuring of the ephemeral species. Some I have had to cultivate in order to study and figure them in all stages. And besides the species figured I have met with some few very minute forms, which probably are distinct species, but which I have not succeeded in figuring and identifying. Still I have reason to believe that the 32 species figured represent the large majority of the Danish species. The number at any rate considerably exceeds that recorded in previous floras.

Spores of all the species are figured on Plate II.

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# KEY

## TO THE SPECIES OF THE GENUS *COPRINUS* FIGURED IN »DANMARKS AGARICACEER«.

A. **Comati**. Young cap covered with felt or scales (recurved or adpressed) formed by filaments (which are made up of cylindric — or irregularly branched — cells).
  α. annulati. Stem with a narrow ring (usually free, occasionally attached to base of stem).
    a. Spores 12—14 μ long. Cap large (about 9 cm high[1]) . *C. comatus* (1)
    b. Spores 15—23 μ long. Cap smaller (2—5 cm high) . *C. sterquilinus* (2)
  β. exannulati. Stem without ring (occasionally with a ringlike zone near the base).
    a. *subglabri*. Cap almost naked, remnants of universal veil forming inconspicuous, adpressed, brownish scales or cobweb-like, orange filaments.
      1. Cap grayish, with adpressed scales (especially in the middle), rather large . . . . . . . . . . . . . . . . . *C. atramentarius* (3)
      (There exists a smaller form (cap 3 cm high) almost devoid of scales: *C. fuscescens* Schaeff.?)
      2. Cap whitish, covered (like the stem) with cobweb-like, orange-red filaments, 2—3 cm high . . . . . . . . . . *C. dilectus* (4)
    b. *tomentosi*. Young cap perfectly covered by (whitish) felt or pilose scales.
      1. *atrospori*. Sporepowder almost black (individual spores dark brown or black).

[1]) I generally give the height of the mature, but unexpanded, cap as the most reliable measure in this genus.

* Veil on young cap forming a felty coating that soon breaks up into patches.
† Cap large (5 cm or more high) . . . . . . . . . . *C. picaceus* (5)
†† Cap smaller (rarely over 3 cm).
° Spores 8—10 μ long . . . . . . . . . . . . . . *C. aphthosus* (6)
°° Spores 11—15 μ long.
§ Stem glabrous; gills soon black . . *C. Rostrupianus* (7)
§§ Stem villoso-tomentose; gills brownish . . *C. velatus* (8)
** Veil on young cap forming squarrose, fibrous scales.
† Medium-sized fungi (cap 1—3 cm high).
° Stem very fragile, woolly; cap membranaceous, splitting, edge upturning . . . . . . . . . . . . *C. lagopus* (9)
°° Stem rather firm, somewhat scaly, rooting; cap somewhat fleshy . . . . . . . . . . . . . . . *C. fimetarius* (10)
†† Very small (cap 0,2—0,5 cm high) . . . . . . . *C. radiatus* (11)

2. *phæospori* Sporepowder dark brown, spores (sub. micr.) translucid, date-brown. (conf. no. 8).
* Veil formed of cylindric cells (with irregular branchlets), soon pealing off.
† Spores triangular-subrotund, somewhat flattened *C. Friesii* (12)
†† Spores broadly oval . . . . . . . . . . . . . . *C. phæosporus* (13)
** Veil dimorph: formed of cylindric, unbranched cells above and globular cells below, soon breaking up into minute granules . . . . . . . . . . . . . . . . . . . *C. domesticus* (14)

B. **Farinosi.** Young cap covered with meal or glistening particles (formed of globular cells). (Conf. no. 14).
α. annulati. Stem with a free ring . . . . . . . . . . . *C. ephemeroides* (15)
β. exannulati. Stem devoid of ring.
a. *vestiti.* Veil forming a rather thick coating on surface of young cap.
1. Veil forming a continuous layer of loose meal.
* Spores small ($6^1/_2$—8 μ long), broadly lemon-shaped or roundish subcordate. Cap very minute (2—4 mm high) *C. cordisporus* (16)
** Spores larger, or oval.
† Veil snow-white. Spores large, (12—18 μ long) . *C. niveus* (17)
†† Veil grayish or dirty white. Spores smaller (8—13 μ long).
° Cap (when bruised) with a nauseating, foetid smell. No sclerotia . . . . . . . . . . . . . . . . . . . *C. narcoticus* (18)
°° Smell faint or none.
§ Medium-sized (cap 1—2 cm high). Generally springing from small, black sclerotium *C. stercorarius* (19)
§§ Small (cap 1 cm high or less). No sclerotia.
› Cap 2—3 mm high (grows on cow-dung) *C. velox* (20)
» Cap 3—10 mm high (grows on the ground among dead foliage, twigs etc.) . . . *C. cortinatus* (21)

2. Veil breaking up into small, granular squamules.
   * Veil on young cap bright fulvous or tile-red . . . *C. curtus* (22)
   ⁑ Veil whitish (in the middle somewhat brownish). (Conf. also no 14) . . . . . . . . . . . . . . . . . *C. angulatus* (23)

b. *micacei*. Veil reduced to a thin sprinkling of loose, glittering particles . . . . . . . . . . . . . . . . . . . . . . . . . . . *C. micaceus* (24)

C. **Nudi**. Cap naked. Veil none.

α. setulosi. Cap (sub lente) sparingly set with minute bristles or setulæ among the ordinary roundish surface-cells.

a. Cæspitose growth.
1. Cap large (2 cm high or more), somewhat fleshy . . *C. tardus* (25)
2. Cap small (less than 2 cm) . . . . . . . . . . . . *C. disseminatus* (26)

b. Solitary growth.
1. Young cap striate, soon radiately split and somewhat diffluent (0,3 – 2 cm high) . . . . . *C. ephemerus* (and its allies) (27)
2. Young cap deeply grooved, not diffluent ($1^1/_2$ – 3 cm high) *C. impatiens* (28)

β. glabri. Surface of cap without setulæ, exclusively formed af subglobose cells.

a. Spores ovate.
1. Cap rather large (more than $1^1/_4$ cm high); stem firm (3 – 4 mm thick) . . . . . . . . . . . . . . . . . . . . . . *C. Hansenii* (29)
2. Cap smaller; stem fragile ($1^1/_2$ mm thick) . . . . . . *C. sociatus* (30)

b. Spores subrotund-cordate, somewhat flattened.
1. Cap about 1 cm high; (grows on the ground) . . . *C. plicatilis* (31)
2. Cap very small (1 – 3 mm high); (on cow-dung). . . . *C. miser* (32)

# SYSTEMATIC AND FLORISTIC NOTES ON THE SPECIES.

## A. COMATI.

1. **Coprinus comatus** (Schum. in Fl. D.).

Spores $11^1/_2$—$14 \times 7$—$8^1/_2$, ovate-oval. — Surface of cap formed of septate, mostly 7—16 μ thick filaments (1914).

Figured specimens: Fruens Bøge, border of lane, Oct. 1896. — Common on roadsides, grassy lanes, wood-paths etc.; more rarely met with in cultivated fields on rich soil. — *C. ovatus* Schaeff., like other modern authors, I regard as a mere form of this species.

2. **C. sterquilinus** Fr.

Spores ovate-ellipsoid, very large, $15$—$23 \times 10$—$13$ μ, when ripe very dark and opaque.

Fig. specim.: Horsens, on heap of old dung from hotbed, Aug. 1909. — Also found in Fruens Bøge, on heap of horse-dung in garden, Sept. 1910.

The ring is either free or attached to the base of the stem, (thus forming a volvaceous edge). The young cap is white, squarrosely scaly. The stem turns black with age.

3. **C. atramentarius** (Bull.).

Spores ovate-ellipsoid, $7^1/_2-8 \times 5$ μ (I) or $9 \times 5^1/_2$ μ (II). — Scales on cap made up of filaments formed of cylindric cells; cystidia cylindric-sackshaped, about 25 μ broad (1914).

Fig. specim.: Hjallese, on the ground close by a wooden frame, July 1897; and at the base of an old Populus, Sept. 1898. — Very common, especially at the base of trees on rich soil, generally clustered. — A white variety was found by me in 1914 in a garden.

[*C. soboliferus* Fr. seems to be nothing but a large form of this species. — On the ground in moist foliaceous woods a

small, rather solitary-growing form is occasionally met with. This variety has an almost naked cap and probably is identical with *C. fuscescens* Schaeff.].

4. **C. dilectus** Fr.

Spores ovate-ellipsoid, 10 × 6 μ. Edge and surface of gills set with ovate, vesiculose cystidia (average breadth 23 μ). The red filaments on the cap are (sub micr.) pale yellow, about 11 μ broad.

Fig. specim.: Hjallese, in copsewood, on rubbish-heap (sticks, coke, decaying boards etc.), aggregate, Aug. (and Sept.) 1904.

The young cap and the stem (especially towards the base) are clad with a very subtile, arachnoid felt of orange-red colour. The base of the stem is pilose, but has no true volva.

*C. intermedius* Penz. and *C. roseotinctus* Rea seem to be almost identical, although the coloured veil is described as »mealy«.

5. **C. picaceus** (Bull.).

Spores broadly oval, 16—18 × 12—13 μ (or 13—17 × $9^1/_2$—12 μ). — Felty coating on cap made up of septate, wavy, about 7 μ broad filaments (1914).

Fig. specim.: Brahetrolleborg, wood of Fagus, Sept. 1897. — Common in woods of Fagus, growing solitary on the ground.

6. **C. aphthosus** Fr.

Spores broadly lemon-shaped, $8^1/_2$—10 × $5^1/_2$—$6^1/_2$ μ, black, opaque. Cystidia vesiculose, cylindric-oval, 50—75 × 20—27 μ.

Fig. specim.: Hjallese, in rotten trunk of Salix capræa, Oct. 1901. (Also found on stump of Salix, Juli 1903).

Coating on young cap cottony-felty, later on forming small, somewhat arachnoid scales.

7. **C. Rostrupianus** E. C. Hansen.

Spores oval or ovate-oval, mostly 12—15 × 7—8 μ, opaque, brownish-black. Cystidia vesiculose, ovate-oblong, about 85 × 38 μ. Coating on cap made up of hyphæ formed of irregularly cylindric, 12—20 μ broad cells.

Fig. specim.: Ærholm, alongside a road, on soil mixed with horse-dung, Sept. 1913. — Also found in similar localities, Hjallese and Lindvedgaard, July 1914.

No sclerotia found. But for the rest the description by E. Chr. Hansen (Bot. Zeitung 1897) fits my plant well. From *C. niveus* it is widely different; but the larger specimens approach the description of *C. exstinctorius* Fr.

8. **C. velatus** Quél. (forma *substerilis*).

Spores oval, 11—$11^1/_2$ × $5^3/_4$—6 μ, translucid, pale brown (in my specimens rather scarce and often atrophiate).

Fig. specim.: Langesø, amongst grass behind a shed, in outskirts of wood of Fagus, Aug. 1913.

A substerile form; the gills at first pale pinkish-ochre, then dark grayish-brown. Spores paler than in the type.

9. **C. lagopus** Fr.

Spores oval, $11^1/_2$—$11^1/_2 \times 7^1/_2$ μ (I) or $10 \times 6$ μ (II). Cystidia large, vesiculose, ovate or oblong, about 12—25 μ broad. Pilose scales formed of long septate filaments (which are hyaline or pale brownish), 15—18 μ broad (1914).

Fig. specim.: I. Hjallese, on the ground alongside a path in copsewood, July 1897. II. similar locality, Aug. 1897. — Rather common on the ground and on rubbish-heaps, in shady places.

[*C. tomentosus* Bull. I have often seen specimens which answer perfectly to the description of C. t., but I am unable to distinguish them from large specimens of C. lagopus. They grow in similar localities. — Ricken's fig. of C. t. suggests C. domesticus].

10 a. **C. fimetarius** (L.). (*C. macrorhizus* Pers.).

Spores oval, $9-11 \times 6-7$ μ. Cystidia solitary, large, conic-ovate, up to 60 μ long and about 35 μ broad. (1914: Spores 10—$11^1/_2$ μ long, opaque, blackish-brown).

Fig. specim.: Hjallese, on horse-dung in manure-shed, July 1897. — Very common on dunghills; out of doors chiefly in July—Sept., in sheds etc. to be met with almost all the year round.

10 b. **C. fimetarius** (L.) *var.*

Spores oval, $11-15 \times 7-9$ μ (mostly $13-14 \times 7^1/_2-8$ μ), opaque, almost black. Cystidia large, vesiculose, about 40 μ broad.

Fig. specim.: Hjallese, on rotten hay, Nov. 1912.

Smaller than no: 10 a. Cap very soon naked; stem slender, translucid, at first sparsely clad with long hairs, soon absolutely glabrous. — This form connects 10 a and 11, but has larger spores than either.

11. **C. radiatus** (Bolt.).

Spores oval, $11-12^1/_2 \times 6^1/_2-7^1/_2$ μ. Scales on cap formed of rows of cylindric or ovate cells.

Fig. specim.: Hjallese, on horse-droppings in wood, Aug. 1904. — Very common, in wood and field, in moist weather.

Inodorous. Is almost a miniature of no. 10 a, the unexpanded cap only 1—5 mm high and the stem filiform ($^1/_3-^1/_2$ mm thick).

*C. pilosus* Beck I consider synonymous.

12. **C. Friesii** Quél.

A. Spores ovate-subrotund (slightly angular), $8^1/_2—10^1/_2 \times 7^1/_2$ μ. Sporepowder blackish-brown.

Fig. specim.: Bramstrup, on dead Phragmites-straw, in moist meadow, July 1898.

Not quite typical and possibly a distinct species. The cap is almost glabrous, slightly downy.

B. Spores triangular-subrotund, somewhat flattened, $8—9 \times 6^1/_2$ μ (short diameter only $5^1/_2$ μ), pale date-brown, translucid.

Lundeborg, on dead grass, woodpath, Aug. 1914. — This I consider the typical form. The cap soon becomes glabrous, but is at first clad with small squamules, which are made up of cells like those of no: 13 (which is very closely allied).

C. var. *microspora*. A form with still smaller spores ($6 \times 5—5^1/_2$ μ) I have met with once, growing on bits of straw (from horse-droppings), Hjallese, green walk in copsewood, Aug. 1913.

13. **C. phæosporus** Karst., *var.*

Spores broadly oval, $8^1/_2—9^1/_2 \times 6—6^3/_4$ μ, translucid date-brown. The coating on the cap formed of light brown, thick-walled filaments (4—5 μ broad) with irregular, rectangular, somewhat bifurcate branchlets.

Fig. specim.: Hjallese, on loamy rubbish-heap among germinating grass-seed, Sept. 1904 (solitary specimens). Also found on green walk in foliaceous wood.

Cap $1^1/_2$ cm high, cylindric, covered, especially towards the apex, by a rather dense felty coating, which is somewhat ochraceous and disintegrates into small squamules, which on top of cap are mucronate. Edge of cap soon minutely striate and turning pale lilac. During the night the cap expands, the edge recurves, and the entire surface becomes striate. Sporepowder dark gray-brown. When young this fungus reminds you of C. comatus *en miniature*.

It differs from the description of Karsten by its solitary habit, from 12 B by its oval spores.

14. **C. domesticus** (Pers.).

Spores oval-ovate, gray-brown, $7—8 \times 4^1/_2—5$ μ. — Cystidia (on edge of gills only) globular, about 15 μ broad, with or without a 5—16 μ long, 4—5 μ broad appendice (1914). — Veil formed of two different tissues: the outer one made up of septate, thick-walled, yellow, 8 μ broad filaments; the inner one of globose, hyaline cells.

Fig. specimens: Sorø, open space in wood, on the ground among chips, Oct. 1901. — B. Aalykkeskov near Odense, on the ground in foliaceous wood, 1911. — Not rare, on the ground, especially among chips; also an decaying doorsills etc.

The bud is entirely enclosed in the veil, the outer layer of which is felty-setulose, sub-ochraceous, while the inner is whitish and granulose. When the cap expands, the veil breaks up into minute, granular scales, dispersed on the translucid, radiately splitting cap. — The sporepowder is blackish brown. By the nature of its veil it forms a transition to group B. — *C. similis* B. and Br. (sensu Ricken) seems to be identical.

## B. FARINOSI.

15. **C. ephemeroides** (Bull.).

Spores ovate-subrotund, subtriangular, somewhat flattened, $7^1/_2$—$9 \times 6$—$7^1/_2$ μ, brownish-black. Cystidia globose, 23—30 μ. Cells of granular veil globose or oval, 25—30 μ diam. or $40 \times 18$ μ.

Fig. specim.: Odense, on horse- and cow-dung in pasture, Sept. 1901. — Rather common on horse-droppings and manure-heaps (cow- and horse-dung), in shady places, Aug.—Oct.

This very characteristic little fungus is by some authors referred to *C. Hendersonii* Berk., but differs totally from Fries' description of this species by the mealy-granular coating on the cap. The ring is usually free, but occasionally remains as a volvaceous brim on the slightly swelled base of the stem. This form is probably *C. volvaceo-minimus* Crossl. — *C. bulbillosus* Pat. appears from the description to be identical. As C. ephemeroides is not known from England, while the English authors describe C. Hendersonii as »pruinose«, the two are most likely identical. The description by Quélet of C. H. fits my plant fairly well. — The »free filament« in the cavity of the stem, mentioned by Fries, I have not observed.

16. **C. cordisporus** Gibbs. (Plate I, fig. g).

Spores very broadly lemon-shaped or triangular-subrotund, somewhat flattened, $6^1/_2$—$8^1/_2 \times 6$—$6^1/_2$ μ. Basidia 4-spored. Cells on surface of cap subglobose, 20—40 μ diam.

Fig. specim.: Sollerup, on horse-droppings in a meadow near Arreskov Sø, Oct. 1908.

Cap at first ovate, 1—3 mm high, then convex-expanded, $1^1/_2$—8 mm broad, when young totally covered by a whitish (sub-ochraceous) mealy-granular veil, when expanded radiately fisso-sulcate, disc slightly depressed. Stem 1—2 cm × $^1/_3$ mm, almost glabrous, base slightly mealy-downy.

Smaller than C. ephemeroides and without ring, but for the rest very much like this species. The smallest specimens suggest *C. Gibbsii* (Mass. et Crossl.).

17. **C. niveus** (Pers.).

Spores lemon-shaped-subrotund, slightly flattened, about 12—18 × 10—12 μ (short diameter 8—10 μ).

Fig. specim.: Hjallese, on horse-dung (Oct. 1898) and cow-dung (Sept. 1899) in a grassfield. Common in green fields and other pastures. The »C. niveus« mentioned by Massee (loc. cit.) seems to be C. Rostrupianus (Conf. E. Chr. Hansen, 1897); his »C. stercorarius« is C. niveus.

18. **C. narcoticus** Fr.

Spores ellipsoid, blackish-brown, 12—$13^1/_2 \times 6^1/_2$ μ, opaque, with a hyaline epispore. When deprived of the epispore the spore is narrowly ellipsoid, $11^1/_2 \times 5^1/_2$ μ. Cystidia subglobose, 20—40 μ. The mealy papillose coating is formed of globular, 35—80 μ broad cells, which are sparely and minutely warty.

Fig. specim.: Hjallese, on the ground (in copsewood) on mouldy, rubbish-mixed soil, a number of specimens, July 1914.

This species has very much in common with C. stercorarius, but has no sclerotia. When cut it expands a very disagreeable, nauseating odour. — To judge from the description *C. inamoenus* Karst. is identical.

19. **C. stercorarius** (Bull.).

Spores oval, $10 \times 5^1/_2$ μ. Cystidia sack-shaped. Veil formed of large globular or ellipsoid cells, which at first are somewhat warty-granulate, diam. 30—70 μ.

Fig. specim.: Hjallese on the ground in richly manured garden-beds, July 1898. — Not very common. Also found in loose horse-dung used as topdressing on the ground in palmhouse (Copenhagen 1914).

This fungus (always?) springs from a small black sclerotium. For full description and synonymy see E. Chr. Hansen's paper (1897).

Evidently *C. tuberosus* Quél. is identical. The same may be true of *C. cineratus* Quél. — (C. stercorarius, sensu Massee, is C. niveus).

20. **C. velox** God.

Spores ellipsoid, $7^3/_4$—$9 \times 4^1/_2$ μ, dark brown. Cells on surface of cap globular, warty, 24—40 μ diam.

Fig. specim.: Hjallese, on cow-dung in pasture, Oct. 1904.

This species is very closely allied to no. 19, but very minute (cap only 1—3 mm high, when expanded 2—6 mm); stem $1^1/_2$—2 cm × $^1/_4$ mm, villous (especially towards the base); sclerotia none.

21. **C. cortinatus** n. sp. (Plate I, fig. i).

Spores ovate-ellipsoid, 8—10 × 5—5$^1/_2$ μ, dark grayish-brown (sporepowder black). Cells from mealy surface of cap globular (30—50 μ), from edge of cap cylindric, forming fibrils about 10—20 μ broad, slightly granulate.

Fig. specim.: Hjallese, copsewood, on the ground among short grass, July 1903. (Also occasionally met with in black mould on stumps (Populus, Ulmus), Samsø and Fyn, 1903—07).

Cap ovate, 4—7 mm high, when expanded convex or slightly depressed, 0,8—1,3 cm broad, at first totally covered by a whitish (slightly clay-coloured or sub-ochraceous), loose and scurfy meal, when expanding radiately striate or grooved about halfway, not diffluent. Towards the edge the veil is made up of minute, downy fibrils; these at first connect the cap with the loose downy-villous coating on the stem, which on large specimens forms a very fugacious ringlike zone. Stem 3—5 cm × 1 mm, with narrow cavity. The gills are free, at first pale, then grayish-brown. — My plant has much in common with *C. filiformis* B. and Br., but is twice as large. And C. f., according to Massee, has much smaller spores (5 × 4 μ).

22. **C. curtus** Kalkbr. (Plate I, fig. h).

Spores oval, 10$^1/_2$—12$^1/_2$ × 6$^1/_2$—7$^1/_2$, brownish-black. Sporepowder black. Veil formed of clusters of subglobose, yellowish-brown, somewhat granulate cells (13—20 μ broad).

Fig. specim.: Aalykkegaard near Odense, on horse-droppings in pasture, Sept. 1901. — Also Hjallese, July 1915.

As this characteristic species is only recorded from the Cape, I think it advisable to give a brief description:

Cap oval, 2—4 mm high, at first entirely covered by the crusty, lighter or darker fox-red veil. When expanding it is flat or slightly convex, fisso-sulcate, diaphanous, fusco-pallid, 3—9 mm broad, with a small, slightly depressed disc, and the veil is broken up into very minute granules. The stem is short (1—2 cm × $^1/_3$ mm), hyaline-pallid, pruinose. The gills are linear, free, blackened by the spores.

23. **C. angulatus** Peck (Plate I, fig. j).

Spores obtusely pentangular, with a prominent apical wart, 7—7$^1/_2$ × 6 μ (short diameter only 5 μ), blackish-brown. Basidia 4-spored. Cystidia globose, about 22 μ broad. Cells from surface of cap globose or broadly oval, 25—45 × 22—35 μ, those from apex of cap slightly ochraceous.

Fig. specim.: Langesø, on kitchen-offall (greasy paper, coffee-grounds etc.) in shady backyard, gregarious and somewhat cæspitose, July 1913.

Cap at first ovate-oval, about 1 cm high, whitish, with a mealy coating which is whitish, near the apex light brown and some-

what mucronately papillous. When expanded the cap is obtusely campanulate-convex, fisso-sulcate almost to the centre, $1^1/_4$—$2^1/_4$ cm across, pale grayish. The stem is glabrous, rather short (3 cm × 2 mm), base slightly bulbous and set with squamules like the cap. Gills free (but without a collarium), at first pale lilac-brown, then black. Sporepowder black.

I refer this species to C. angulatus Peck, which as far as I know has not been met with in Europe before. *C. Patouillardi* Quél. and *C. papillatus* Batsch as well as *C. Coffeæ* Comes may however be identical. When only half-way expanded it has a superficial likeness to C. disseminatus; when expanded it is not unlike a little C. domesticus.

24. **C. micaceus** (Bull.).

Spores lemon-shaped, 8—11 × 5 (or $7^1/_2$—10 × 4—5 μ].

Fig. specim.: Hjallese, on and around stump, Oct. 1896. — Very common, densely clustered, at the base of trunks (of foliaceous trees) or on the trunks themselves.

## C. NUDI.

25. **C. tardus** Karst.

Spores broadly lemon-shaped, 12—15 × 7—9 μ, opaque, black. Cystidia vesiculose, very large, conically flask-shaped, up to 24 μ broad. The surface of the cap is sparingly set with minute, erect, hyaline setulæ or bristles (cystidia?), about 120 μ long.

Fig. specim.: Hjallese, fasciculate, on clayish soil, open space in wood, Oct. 1898. — Not uncommon, till late in the autumn (1912 even in January), in woods and gardens. Its habit is intermediate between C. micaceus and C. impatiens, but it is larger than either. (But for the »höckerig-rauen« spores *C. tergiversans* Fr. (sensu Ricken) would be almost identical).

26. **C. disseminatus** (Pers.) Quél. (*Psatyrella disseminata* Fr.).

Spores $8^1/_2$—9 × $4^1/_2$—5 μ. Cystidia 0. Surface of cap with a) globular cells (about 40 μ diam.), b) cylindric, erect cells (100—130 μ long) with somewhat granulate membrane. The cylindric or borst-like cells are also met with on the edge of the gills near the margin of the cap.

Fig. specim.: Hjallese, on and around stump of Populus, June 1896. — Very common about stumps and trees (especially Populus) in dense masses (consisting of hundreds and hundreds). Several generations (3—4) may appear on the same stump, some six weeks after each other.

27 a. **C. ephemerus** (Bull.).

I) Spores ovate, $10 \times 6^1/_2$ μ. Cystidia vesiculous. [Also spores $9^1/_2$—$10 \times 5$—$5^1/_2$ μ, ovate-ellipsoid, dark brown; basidia $9^1/_2$ μ broad, paraphyses 15—25 μ. Hairs on surface of cap 46—60 μ long, smooth. Cystidia on gills about 16 μ broad, with or without a bottleneck-like contraction of the upper portion. 1914].

Fig. specim.: Hjallese, on path in foliaceous wood, July 1897. (1914, in similar locality, Killerup, October).

II) Spores 10—16 × 6—8 μ (mostly 11—15 × $6^1/_2$—$7^1/_2$ μ) blackish brown. Setulæ on cap about 50 μ. Cystidia on gills globular or somewhat conical, free portion up to 50 μ long.

Fig. specim.: Killerup, on roadside-bank behind a wood, Oct. 1901. — The two forms are almost identical, only the spores differ materially in size.

[On horse- and especially cow-dung in pastures a fungus is met with everywhere, which I cannot clearly distinguish from C. ephemerus (II). Like other coprobious Coprini it varies very much in size (unexpanded cap 2—13 mm high); small specimens are generally pale, the bigger ones subochraceous. It is rapidly diffluent (much more so than C. ephemerus I and II). From all other coprophile species it is most easily distinguished by the minute erect setulæ on the — apparently naked — young cap. To this type evidently belong *C. proximellus* Karst., *C. conditus* Gill. and probably also *Psatyrella subtilis* Fr. See also additional note page 50].

27 b. **C. ephemerus** (Bull.) **var.**?

Spores ellipsoid, opaque, 11—13 × $6^1/_2$—7 μ. Setulæ on cap 60 μ.

Fig. specim.: Hjallese, on heap of rubbish and rotten sticks, July 1903. — Differs from large specimens of no. 27 a chiefly by its larger (2 cm high), at first dark brown, when expanded somewhat paler, campanulate cap. — The stem is setulous like the cap.

28. **C. impatiens** (Fr.) Quél (*Psatyrella impatiens* Fr.).

Spores ovate-oval $8^1/_2$—11 × 6 (or $9^1/_2$—12 × 5—$6^1/_2$ μ). Cystidia somewhat flask-shaped or almost like the hairs of the nettle. [1914: Surface of cap with erect setulæ (cystidia) (about 100 μ long). Hymenium of the Coprinus-type, with sterile cells (paraphyses) between the fertile basidia. Spores dark date-brown, slightly pellucid. Sporepowder blackish-brown].

Fig. specim.: Trolleborg, in wood of Fagus, border of meadow, Sept. 1897. — Not uncommon, especially in the outskirts of foliaceous woods, on the ground, solitary or scattered.

Easily recognized by the cap, which, even before expanding, is deeply grooved (short and long grooves alternating in a very regular manner). Whether *C. (Psatyrella) hiascens* is a species really distinct from C. impatiens appears to me rather dubious.

29. **C. Hansenii** n. sp. (Plate I, fig. k).

Spores oval-ovate, 12—13 × 7 μ, dark grayish-brown, slightly pellucid. Basidia 9—10 μ diam.; paraphyses 17—18 μ. Cystidia vesiculous, somewhat bottle-shaped, with a short or rather long neck, about 20 μ broad. The surface of the cap is formed of balloon-shaped or almost pyriform cells (16—24 μ broad).

Fig. specim.: Hunderup, on the ground near a dead stump of Populus, June 1902. — Also Horsens, 1908, and Lundeborg, Aug. 1914, on naked ground behind a garden-hedge.

Cap at first oval-cylindric, $1^1/_4$—2 cm high, dark rufous chestnut-brown (apex darker), naked, striate, then expanded, at last flat, fisso-sulcate $^2/_3$ way up (disc flat or slightly depressed), 3—$4^1/_2$ cm across, of a lighter and paler brownish colour than the bud. Stem rather tough, whitish (tinted slightly brownish), inside sub-ochraceous, fistulose, glabrous, top somewhat striate, 7—9 cm × 3—4 mm. Gills free, narrow, at first pale, then ochaceous-brown, at last black, hardly diffluent. Subfasciculate.

Having found no description anywhere of this characteristic species I have named it C. Hansenii in commemoration of the Danish biologist and mycologist Emil Chr. Hansen, author of Fungi fimicoli Danici.

30. **C. sociatus** Fr. (?).

Spores ovate-oval, 12 × 7 μ, dark gray-brown, slightly pellucid. Sporepowder brownish black. Cystidia somewhat bottleshaped with a broad neck, 20—25 μ broad. Surface of cap made up of globular or balloonshaped cells, 25—40 μ diam., hyaline or slightly brownish.

Fig. specim.: Hjallese, solitary growing on border of woodpath, July 1914. Cap campanulate, 1 cm high, at last expanded, up to 2 cm across, surface grayish-ochraceous-brown, apex subfulvous, naked (without veil) but (sub lente) seen to be formed of glistening particles (globular cells), at first deeply striate, then fisso-sulcate almost to apex. Stem 5 cm × $1^1/_2$ mm, apex slightly dilated, glabrous, whitish. Gills lanceolate-linear, free, soon blackish.

This plant differs from the description of C. sociatus by its solitary habit. Its microscopic characters are almost like those of no: 29, but it has the stature of C. plicatilis, from which it is however easily recognized by the spores, by the cap not having a depressed disc, by the darker brown colour and the glittering surface-cells. From large forms of C. ephemerus it differs in having no setulæ on surface of cap.

31. **C. plicatilis** (Curt.).

Spores subrotund-lemonshaped (almost like the seeds of Polygonum lapathifolium) somewhat flattened, $9^1/_2$—11 × 8—$9^1/_2$ μ

(short diameter $6^1/_2$ μ). Cystidia vesiculous, sackshaped or somewhat bottleshaped, 25 μ broad. Surface of cap formed of balloonshaped, hyaline cells (20—35 μ diam.).

Fig. specim.: Hjallese, old lawn, July 1897. — Very common in grass. — In woods (on foot-paths etc.) a paler, more campanulate form is not uncommonly met. This probably is the *C. hemerobius* of Fries. But I do not think it specifically distinct. Fries places the two species in different groups; C. hemerobius he regards as glabrous, while C. plicatilis is placed in »furfurelli«. But as a matter of fact both are perfectly naked.

32. **C. miser** Karst. (Plate I, fig. 1).

Spores subrotund-triangular, somewhat flattened, $8 \times 7$ μ (short diam. 5 μ), black, impellucid. Surface of cap formed of ovate-globose, about 18 μ broad cells.

Fig. specim.: Aalsbo, on cow-dung in pasture, under Betulas, Oct. 1899. — Apparently not rare, on cow-dung in copsewoods and pastures, but easily overlooked.

This very minute species I formerly referred to *C. Schroeteri* Karst. (sensu Schroeter), but it has much smaller spores. I refer it now to C. miser Karst., although the author describes this species simply as »hyalino-cinerellus« and does not mention that the young, unexpanded cap is more bright-coloured, orange or tile-red, especially towards the apex. From minute specimens of the *C. ephemerus*-type it is most easily recognized by being absolutely glabrous, and by the spores.

Besides these 32 species some few others are recorded from Denmark.

*C. oblectus* (Bolt.) is mentioned by E. Chr. Hansen as found on manured ground near Copenhagen in 1875. It has not been observed since. — Ricken (loc. cit.) regards it as a mere form of C. sterquilinus.

*C. alternatus* (Schum.). This species has not — as far as I know — been met with since the time of Schumacher (a. 1800). It seems to be variously conceived by the different authors.

*C. deliquescens* Fr. is recorded by Sev. Petersen (loc. cit.) from Slagelse Skov. Cooke's figure of this species has very much in common with some forms of C. atramentarius.

*C. digitalis* (Batsch). Also recorded by Sev. Petersen from Slagelse, but regarded by him as a dubious species.

*C. sceptrum* Fr. has been found by Sev. Petersen in Jylland and *C. diaphanus* Quél. near Sorø. They appear from the description to be almost identical. Until it is ascertained whether they are really glabrous, or minutely setulose like C. ephemerus, the question of their systematic position cannot be settled. They (especially C. diaphanus) seem to have much in common with C. ephemerus.

*C. congregatus* (Bull.). — A fungus very much like this species I have met with in foliaceous wood, on grassy drive, growing in large and dense clusters. I have not had the opportunity to study it further, as it has not reappeared for several years.

Additional note.

**C. bisporus** n. sp.

Immediately before the going to press of this paper I have met with a Coprinus of the C. ephemerus-type which differs from all other Coprini examined by me in having constantly 2-spored basidia, and which I therefore think deserves a specific name, although macroscopically it differs but very little from its 4-spored allies. — Like the forms mentioned sub no. 27 a. it grows as well on dung as amongst grass. Probably the large-spored 27 a II belongs here. I add a brief description:

Young cap 0,5—1,2 cm high, ovate, pallid (like C. disseminatus), apparently naked, but set with minute, erect setulæ. When expanding it becomes grayish-hyaline, radiately sulcate and at last somewhat recurved and diffluent.

The gills are narrow, reach the stem and soon become blackish. The stem is 3—8 cm $\times$ 1—1,5 mm, glabrous, translucid. Setulæ on cap 60—120 $\mu$ long. Spores ovate-ellipsoid, $12^1/_2 \times 6^1/_2$ $\mu$ opaque, blackish-brown (sporepowder black). Basidia constantly 2-spored, 9 $\mu$ broad. Cystidia inflated ovate, about 18 $\mu$ broad.

Fig. specim.: Hjallese, on rubbish-heap and horse-dung in wood July 1915. — Also met with on borders of road and green walk in wood in same locality.

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Luc. Quélet: Flore Mycologique de la France, Paris 1888.

Luc. Quélet et F. Bataille: Flore monographique des Amanites et des Lepiotes. Paris 1902.

Ad. Ricken: Die Blätterpilze. Leipzig 1910.

# SPECIFIC INDEX.

# PLATE I.

| | | | |
|---|---|---|---|
| *a.* | Lepiota | gracilis | (natural size) |
| *b.* | — | Cortinarius | — |
| *c.* | — | helveola var. | — |
| *d.* | — | Forquignoni | — |
| *e.* | — | hispida | — |
| *f.* | — | echinella | — |
| *g.* | Coprinus | cordisporus | (nat. size and $\times 3$) |
| *h.* | — | curtus | — |
| *i.* | — | cortinatus | — — |
| *j.* | — | angulatus | (natural size) |
| *k.* | — | Hansenii | — |
| *l.* | — | miser | (natural size and $\times 3$) |


Jacob E. Lange del. N. Ha[illegible] Lith. [illegible] Tryk

# PLATE II.

All spores shown magnified 800 times, cystidia and surface-cells 300 times. The numbers correspond with the current no: of each species in the text.

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## Amanita.

1. A. virosa . . . . . . . . . . . spore.
2a. - phalloides . . . . . . . . . —
2b. - — forma citrina —
3. - porphyria . . . . . . . . . —
4. - — recutita . . . . —
5. - Mappa . . . . . . . . . . .
6a. - muscaria . . . . . . . . . . —
6b. - — aureola . . . .
7. - pantherina . . . . . . . .

8a. A. excelsa . . . . . . . . . . . spore.
8b. - — pallida . . . . . . —
9. - spissa . . . . . . . . . . . . —
10. - aspera . . . . . . . . . . . -
11. - rubescens . . . . . . . . . —
12. - vaginata . . . . . . . . . . —
13. - strangulata . . . . . . . . -
14. - lenticularis . . . . . . . . -

## Lepiota.

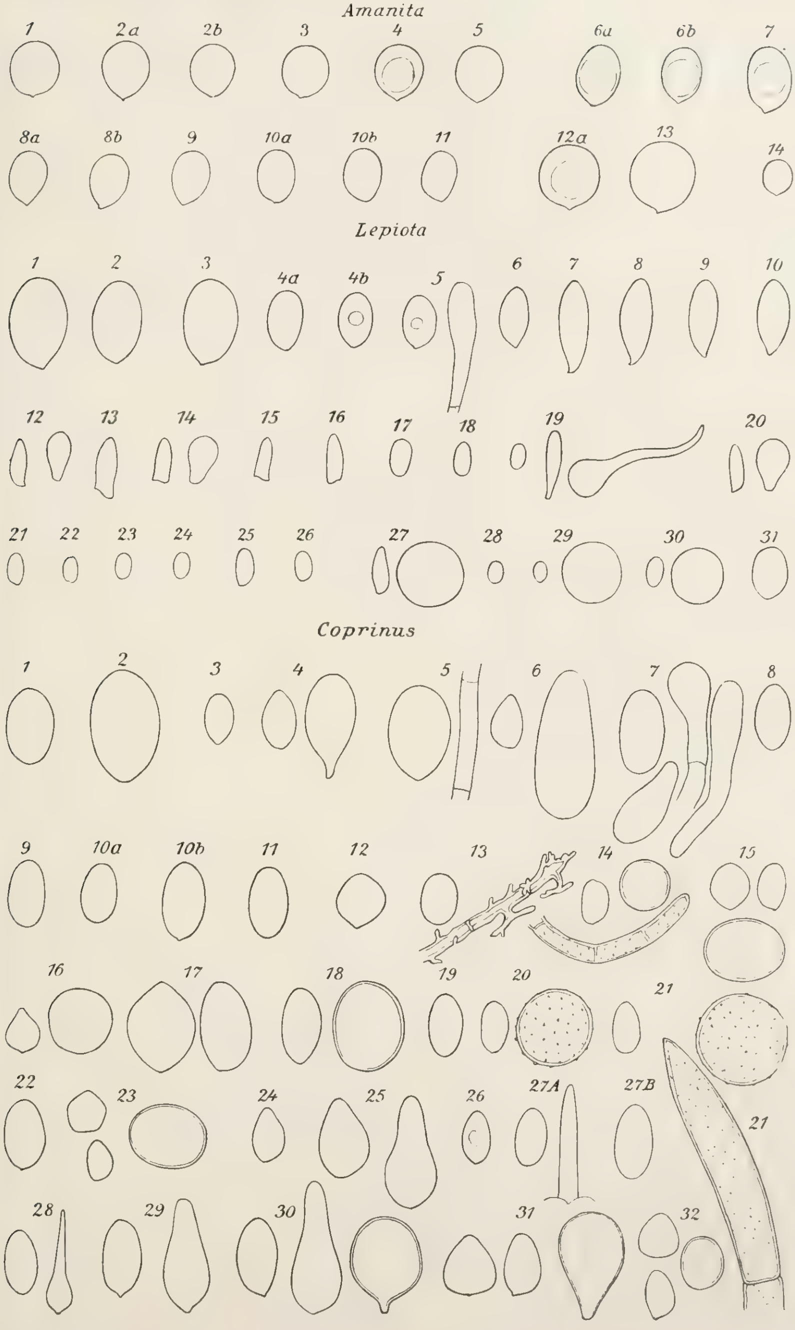
1. L. procera . . . . . spore.
2. - umbonata . . . . —
3. - excoriata . . . . —
4a. - rhacodes . . . . . —
4b. - — puellaris —
5. - naucina . . . . . — & cystidium.
6. - felina . . . . . . . —
7. - clypeolaria . . . —
8. - — metulispora —
9. - gracilis (lævigata) —
10. - erminea . . . . . —
11. - —
12. - Cortinarius . . . — & cystidium.
13. - castanea . . . . . —
14. - cristata . . . . . — & cystidium.
15. - helveola var. . .
16. - albo-sericea . . . —

17. L. Forquignoni . . . spore.
18. - Morieri . . . . . . —
19. - micropholis . . . . —, cystidium a. surface-cell.
20. - acutesquamosa . .
21. - hispida . . . . . . —
22. - echinella . . . . . . —
23. - cinnabarina . . . . —
24. - granulosa . . . . . —
25. - amianthina . . . . —
26. - Carcharias . . . . —
27. - Bucknalli . . . . . — & surface-cell.
28. - seminuda . . . . . -
29. - — parvannulata — & surface-cell.
30. - hæmatosperma . .
31. - mellea . . . . . . . —

Plate II.

## Coprinus.

| | | | |
|---|---|---|---|
| 1. | C. comatus. . . . . | spore. | |
| 2. | - sterquilinus . . | — | |
| 3. | - atramentarius . | — | |
| 4. | - dilectus . . . . . | — | and cystidium. |
| 5. | - picaceus . . . . | — | and cell of filament. |
| 6. | - aphthosus . . . | — | and cystidium. |
| 7. | - Rostrupianus . | — | and 3 surface-cells. |
| 8. | - velatus . . . . . | — | |
| 9. | - lagopus . . . . . | — | |
| 10a. | - fimetarius . . . | — | |
| 10b. | - — var. | — | |
| 11. | - radiatus . . . . | — | |
| 12. | - Friesii . . . . . | — | |
| 13. | - phæosporus . . | — | and part of surface-filament. |
| 14. | - domesticus . . . | — | globose cells and end of filament. |
| 15. | - ephemeroides . | — | (from face and side) and surface-cell. |
| 16. | - cordisporus . . | — | and surface-cell. |
| 17. | - niveus . . . . . | — | (from face and side). |
| 18. | - narcoticus . . . | — | and cystidium. |
| 19. | - stercorarius . . | — | |
| 20. | - velox . . . . . . | — | and surface cell. |
| 21. | - cortinatus . . . | — | globose surface-cell and end of filament. |
| 22. | - curtus . . . . . . | — | |
| 23. | - angulatus . . . . | — | (from face and side) and surface-cell. |
| 24. | - micaceus . . . . | — | |
| 25. | - tardus . . . . . . | — | and cystidium. |
| 26. | - disseminatus . . | | |
| 27a. | - ephemerus . . . | — | and surface-cystidium. |
| 27b | - — . . . | — | |
| 28. | - impatiens . . . | — | and cystidium from edge of gill. |
| 29. | - Hansenii . . . | — | — — |
| 30. | - sociatus . . . . . | — | cystidium and surface-cell. |
| 31. | - plicatilis . . . . | — | (from face and side) and surface-cell. |
| 32. | - miser . . . . . . | — | — — |

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# A List of Phytoplankton from the Boeton Strait, Celebes

by

**C. H. Ostenfeld.**

A couple of years ago an old school mate of mine, Mr. P. Th. Justesen, who is now a military surgeon (Offic. v. Gezondh. 1. kl.) in the Dutch Indian Government, brought me a big lot of drawings of plankton organisms. During his stay at one of the small military places in the Dutch Indies he had used his leisure time to collect plankton in the sea and to examine the samples under the microscope. As he had only very little literature concerning this subject at hand, he was not able to identify the organisms which he found by his microscopical examination, but made very good and careful drawings of all the forms he could distinguish. When he showed me these drawings, he asked me if I could do anything with them. After a preliminary inspection I told him that I would be able to identify a good deal of the protophytes (and some of the protozoa) from the drawings, and that it would be worth while to publish a list of the organisms as far as they were discernible, as our knowledge of the marine plankton of the Malay Archipelago is rather poor. Of course it was not possible to identify all the drawings, and therefore I asked Dr. Justesen if he did not preserve the samples from which the figures were drawn. He told me that he had not kept the samples separately, but had placed parts of them all into one bottle with formaline, and this he handed me for examination. As all his samples were taken at the same spot, this common sample might have been very useful, but unfortunately the preservation was not good, and the shaking of the bottle had spoiled many of the larger protophytes. Therefore my examination gave only a rather poor result; still, it was of

value in several cases where the drawings were not determinable. as for instance with regard to the genus *Coscinodiscus*.

In a letter Dr. Justesen sent the following remarks concerning his plankton researches: »My plankton collections were made during the years of 1909 and 1910 in the Baoe-Baoe Bay on the west side of Boeton island, Lat. 5° 30′ S., Long. 122° 30′ E. [S. E. of the big island of Celebes]. The bay is situated at the southern end of the Boeton Strait near the entrance to the Flores Sea. A very strong current runs through the strait, out or in according to the tides. The depths in the strait are everywhere moderate, not exceeding 100 m.; at the collecting place it measures only 15 m. The bottom and the coasts consist of coral formations. The collecting was made by means of an ordinary surface net (mesh width of gauze not known) towed behind a rowing boat; sometimes the net was used vertically. Samples were taken at all hours of the day, sometimes also during the night (before midnight). During the last part of 1910 I found always only organisms which I had seen before and already drawn, and I got the impression that there was nothing more to be found.«

In the spring of 1913 I had the drawings for closer examination and identified somewhat more than half of the figures, the number of which was about 350. I also examined and made some slides of the common sample, and noted what I was able to identify. But I was prevented from finishing my work by a voyage to the West Indies, and therefore returned the drawings to Dr. Justesen (by chance a few were kept by me). Last year another long voyage followed, and I have not until now had any opportunity of fulfilling my duty by publishing a list of all the protophytes which I have been able to identify from Dr. Justesen's drawings and from the sample. In the following I enumerate only those organisms as to the identification of which I feel pretty sure; therefore the list does not pretend to give a full account of the plankton organisms of the Boeton Strait. Some larger genera (*Rhizosolenia*, *Chaetoceras*, etc.) are much richer in species than the list indicates; but many of the drawings did not permit of any idenfication, as the characters necessary for such were not marked. Still, the list is rather long, and shows a large number of species (101) occurring in the plankton of the Boeton Strait.

The plankton of the Malay Archipelago has been investigated by Cleve and, to a lesser degree, by other scientists. The

principal papers containing records from the Archipelago and its neighbourhood are the following:

Castracane, F. (1886): Report on the Diatomaceæ collected by H. M. S. Challenger during the years 1873—76. The Voyage of H. M. S. Challenger. Botany, vol. II, London 1886.

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In the following list I have enumerated the genera alphabetically within the main divisions (*Schizophyceæ*, *Silicoflagellata*, *Peridiniales* and *Bacillariaceæ*) and the species alphabetically within the genera, as it is easier to find a name in that way, than if the consecutive order was systematical. Under each species I have quoted the place where it was described, and in addition, at least one good drawing of it. In some cases I have found it necessary to alter the names or give new names.

The general character of the plankton is that of a tropical neritic plankton; it resembles very much the plankton examined by Cleve (1901) and myself (1902) from the Malay Archipelago and the Gulf of Siam respectively.

## I. Schizophyceae.

**Lyngbya aestuarii** (Mert.) Liebman, Krøyers Tidskr., København 1841, p. 492. Probably only accidentally in the plankton.

**Richelia intracellularis** Johs. Schmidt, Vid. Medd. Naturh. Forening, København, *1901*, p. 146, fig. 2.

To judge from the numerous drawings this interesting endophyte must be very common in the plankton of the Boeton Strait. It always occurred in *Rhizosolenia styliformis* and related species.

**Trichodesmium Thiebautii** Gomont, Journ. de Botanique, 1890, *4*, p. 356; Ann. Sc. nat. VIIe sér., 16, Botanique 1892, p. 197, tab. VI, figs. 2—4.

Both drawn by Dr. Justesen and found by me in the sample.

## II. Silicoflagellata.

**Dictyocha fibula** Ehbg. var. **stapedia** (Haeck.) Lemmermann, Ber. d. Deutsch. bot. Ges., *19*, 1901, p. 261.

Found very rarely in the sample.

## III. Peridiniales.

**Amphisolenia bidentata** B. Schroeder, Mitteil. zool. Stat. Neapel, *14*, 1900, p. 20, fig. 16.

P. T. Cleve (1901, p. 13) records *A. palmata* Stein from the Malay Archipelago (and not *A. bidentata*), but it is probably the same species as that to which I have given Schroeder's name. The question is if the two names are synonymous or not; but until Stein's form has been found again, we can not come to a decision in the matter. As far as can be judged from the drawings, the two forms seem to differ in the shape of the posterior part of the hypotheca. —

With regard to the difficult genus *Ceratium* I follow E. Jørgensen's excellent monograph [1]), which I quote under each species.

**Ceratium breve** (Ostf. et Schmidt) B. Schröder, Vierteljahrschr. d. naturf. Ges. Zürich, *51*, 1906, p. 358; Jørgensen, l. c., p. 40, fig. 84; *C. tripos* v. *brevis* Ostenfeld og Schmidt, Vid. Medd. Naturh. For. København, *1901*, p. 164, fig. 13.

I have identified several drawings with this form. Besides the main species the var. **parallelum** (Schmidt, Bot. Tids., *24*, 1901, p. 213, fig. 1) Jørgensen, l. c., p. 41, fig. 86, was also present.

**C. candelabrum** (Ehbg.) Stein, Organ. d. Infusionsthiere, III, 2., 1883, tab. XV, figs. 15—16; Jørgensen, l. c., p. 16, fig. 21.

Rare; a single drawing.

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[1]) E. Jørgensen: Die Ceratien. Eine kurze Monographie der Gattung Ceratium Schrank. Leipzig 1911 (W. Klinkhardt).

**C. dens** Ostenfeld et Schmidt, l. c., p. 165, fig. 16; Jørgensen, l. c., p. 31, fig. 58.

This species occurs in chains; one of Dr. Justesen's drawings shows a chain consisting of 4 individuals.

**C. extensum** (Gourret) Cleve, The seasonal distribution of Atlant. Plankton Organisms, Göteborg, 1901, p. 215; Jørgensen l. c., p. 28, fig. 50.

Drawn by Dr. Justesen.

**C. furca** (Ehbg.) Dujardin, subsp. **eugrammum** (Ehbg.) Jørgensen, l. c., p. 17, fig. 24–26.

Both a form with shorter horns (answering to Jørgensen's fig. 24) and one with longer horns (Figs. 25–26) were found.

**C. fusus** (Ehbg.) Dujardin, subsp. **seta** (Ehbg.) Jørgensen, l. c., p. 29, fig. 55.

Drawn by Dr. Justesen.

**C. deflexum** (Kofoid) Jørgensen, l. c., p. 64, fig. 138; *C. macroceras deflexum* Kofoid, Univer. Calif. Public., Zoology, III, 13, 1907, p. 304, tab. 24, fig. 13–15.

Was found rarely in the sample.

**C. gallicum** Kofoid, l. c., p. 302, tab. 24, fig. 10–12; *C. macroceras*, subsp. *gallicum* Jørgensen, l. c., p. 63, fig. 134–135.

To this species I refer the figures of *C. macroceras* published by Ostenfeld and Schmidt (l. c., fig. 19), Okamura and Nishikawa (Annot. Zool. Japon. V, 3, 1904, fig. 2, reversed) and Okamura (Annot. Zool. Japon. VI, 2, 1907, pl. IV, fig. 19) besides those quoted by Kofoid and Jørgensen.

**C. gibberum** Gourret, f. **sinistrum** Gourret, Ann. Musée d'hist. nat. de Marseille, Zool., I, 8, 1883, p. 36, tab. 2, fig. 34; Jørgensen, l. c., p. 50, figs. 107–109.

Both drawn by Dr. Justesen and found by me in the sample.

**C. inflexum** (Gourr.) Kofoid, Univ. Calif. Public. Zoology, 1908, IV. 7, p. 388; Jørgensen, l. c., p. 76, figs. 160–161.

This species is very close to *C. trichoceras* (Ehbg.) Kofoid (l. c., p. 388; Jørgensen, l. c., p. 75, fig. 159), but still I think that my identification of Dr. Justesen's two drawings is correct.

**C. massiliense** (Gourr.) Jørgensen, l. c., p. 66, figs. 140–142.

I do not know if Jørgensen is right in using this name for the common long-horned tropical *Ceratium*-species which has quite a number of other names, but I think it most convenient, at present, to follow him. The species was very common in the plankton of Boeton Strait as is evident from the many drawings made by Dr. Justesen.

**C. pennatum** Kofoid, Bull. Mus. comparat. Zoology at Harvard Coll., *50*, No. 6, 1907, p. 172, tab. 2, fig. 12; Jørgensen, l. c., p. 26, fig. 48 a.

The drawings show a form which forms a transition from the main species to the var. *falcatum* Kofoid (l. c., fig. 14).

**C. reticulatum** (Pouchet) Cleve, Arkiv f. Zoologi, I, 1903, Stockholm, p. 342; Jørgensen, l. c., p. 86, figs. 182–183.

Drawn by Dr. Justesen.

**C. Schmidtii** Jørgensen, l. c., p. 50, figs. 110, 111; *C. curvicorne* Johs. Schmidt, l. c., p. 215, figs. 3, 4, non Daday. A rare species restricted to the Indian Ocean and the Malay Archipelago.

**C. strictum** (Okamura et Nishikawa) Kofoid, l. c., 1907, p. 172; Jørgensen, l. c., p. 27, fig. 49.

Drawn by Dr. Justesen.

**C. sumatranum** (Karsten) Jørgensen, l. c., p. 73, figs. 153—154.

The specimens drawn correspond well to the f. *angulatum* Jørg. (l. c., p. 74; *C. tripos vultur* v. *sumatrana* Karsten, Deutsche Tiefsee-Exp., Bd. 2, Teil II, Lief. 3, 1907, pl. 48, fig. 15, pl. 51, fig. 14). This species occurs in chains.

**C. vultur** Cleve, Kgl. Svenska Vetensk. Akad. Handl. *34*, No. 1, Stockholm 1900, p. 15, tab. 7, fig. 5; Jørgensen, l. c., p. 71, fig. 151.

The specimens drawn are intermediate between the main species and var. *japonicum* (B. Schröder) Jørg. (l. c., p. 73, fig. 152) and some come close to the variety. It was found in two-celled chains.

**Ceratocorys horrida** Stein, l. c., tab. VI, figs. 4—11. Only one drawing present, which seems to indicate that the species was rare in the Boeton Strait.

**Dinophysis miles** Cleve, Öfv. K. Svenska Vetensk. Akad. Förhandl., 1900, No. 9, p. 1031, fig. 1 a, b.

The two forms of this species to which Cleve (l. c.) has already called attention, seem to be well distinguishable from each other, and I prefer to take them as two subspecies. Both were present in the drawings by Dr. Justesen and both occurred in 4- or 8-celled colonies. Besides the subsp. *Schroeteri* was found by me in the sample. The names of the subspecies must be as follows:

— subsp. **Schroeteri** (Forti) nob.; syn. *Heteroceras Schroeteri* A. Forti, Ber. Deutsch. bot. Ges., Bd. *19*, Heft 1, 1901, p. 6, figs. I—II; *Dinophysis aggregata* Weber-van Bosse, Ann. de Buitenzorg, 2. sér., *2*, 1901, p. 140, pl. XVII, figs. 3—4; *D. miles*, f. *indica* Ostenfeld et Schmidt, l. c., 1901, p. 170.

This is the common form in the Malay Archipelago and the Gulf of Siam.

— subsp. **Maris-Rubri** (Ostenfeld et Schmidt, l. c., p. 170, pro forma) nob.

The common form in the Red Sea where subsp. *Schroeteri* does not seem to occur; on the other hand subsp. *Maris-Rubri* was drawn by Dr. Justesen from Boeton Strait.

**D. pedunculata** (Schmidt) nob.; *D. homunculus*, f. *pedunculata* Johs. Schmidt, Botan. Tidskr., *24*, 1901, p. 221, fig. 8; *D. homunculus* Okamura, Annot. Zool. Japon., VI, 2, 1907, p. 131, pl. V, fig. 40.

Both drawn by Dr. Justesen and found by me in the sample.

There is no doubt that the form which Schmidt (l. c.) took as a variation of *D. homunculus* Stein is an independent species. The old *D. homunculus* Stein is an aggregate of species, of which the following are known at present: *D. homunculus* Stein *sens. str.*, from the Mediterranean and elsewhere; *D. tripos* Gourr., from the Mediter-

ranean, the Atlantic and the South Sea; *D. diegensis* Kofoid, from the Californian Pacific; and *D. pedunculata*, from the Malay Archipelago, the Gulf of Siam and the Sea off Japan.

**Gonyaulax polygramma** Stein l. c., tab. 4, fig. 15. Found in the sample, but very rare.

**Ornithocercus magnificus** Stein, l. c., tab. 23, figs. 1—2; Schütt, Botan. Zeit., 1900, p. 18, figs. 8—10. Found in the sample.

**O. Steinii** Schütt, Botan. Zeit, 1900, p. 18, figs. 5—7; *O. magnificus* Stein, l. c., tab. 23, fig. 4.

Drawn by Dr. Justesen and found in the sample. The drawings show the symbiotic yellow-brown unicellular algæ in the girdle. —

I have only been able to refer some of the many drawings of *Peridinium*-forms to species, as the tabulation and other necessary marks of distinction were not evident. On the other hand several species were found in the sample; they were much better preserved herein than for instance the *Ceratium*-forms.

**Peridinium assymmetricum** (Mangin) nob.; *Peridiniopsis assymetrica* Mangin, Comptes rendus Acad. Sc., *153*, 1911, p. 30; ibid. p. 645; *Diplopsalis lenticula* auctt., e. g. Stein, l. c., tab. 8, figs. 13, 14, tab. 9, figs. 2—5; vix Bergh; *Diplopelta bomba* Jørgensen, Svenska Hydrogr. biol. Komm. Skrifter, *4*, 1912, p. 9.

Owing to the incomplete description and the lack of any tabulation in the figures, the Peridinian described by R. Bergh (Morphol. Jahrb. I, 1881, p. 244, figs. 20—22) as *Diplopsalis lenticula* has been the object of long controversies between E. Jørgensen, L. Mangin, O. Paulsen and J. Pavillard. As far as I understand the matter, all these authors agree in the fact that we have two distinct species under the name *Dipl. lenticula*, a smaller neritic one, and a larger oceanic one; but they differ with regard to the names. I follow E. Jørgensen (l. c., 1912, p. 9) in taking the small neritic species as the true *Dipl. lenticula* of Bergh, as it is this which occurs at the place where Bergh originally studied the organism in question, viz. Little Belt, one of the Danish Waters. Thus we have to chose another name for the larger oceanic species, and Jørgensen revives for it an old manuscript name by Stein; but Stein himself tells us (l. c., p. 12) that he used this name in his notebook for what he afterwards identified as being *Dipl. lenticula* — that is for both species; this name is therefore not a valid one. Therefore we must take Mangin's name: *Peridiniopsis assymetrica*.

The recent closer studies of the tabulation of the small Peridiniums and related forms show such a variation of plate arrangement, that I prefer, as O. Paulsen (Bulletin trimestriel, Résumé planktonique, 3 part, 1913, p. 265) has done, to unite all the related genera (*Peridinium* Ehbg., *Peridiniopsis* Lemm., *Preperidinium* Mangin, *Diplopsalis* Bergh and *Diplopsalopsis* Meunier) into one genus, viz. *Peridinium*. The species which must be transferred to *Peridinium*, are the following: *Peridinium lenticula* (Bergh) Pauls. (syn. *P. Paulsenii* Mangin; *P. Meunieri* Pavillard; *Diplopsalis lenticula, f. minor* Pauls.; *Dipl. sphærica* Meunier); *P. assymetricum* (Mangin) nob.; *P. caspicum* (Ostf.)

Lemm.; *P. pillula* (Ostf.) Lemm.; *P. Manginii* nov. nom. (syn. *Diplopsalis minima* Mangin, non *Perid. minimum* Schilling); *P. saecularis* (Murr. et Whitt.) nob. (syn. *Dipl. saecularis* Murray and Whitting); *P. Borgei* (Lemm.) Lemm. (syn. *Peridiniopsis Borgei* Lemmermann); *P. Cunningtonii* (Lemm.) Lemm. (syn. *Peridiniopsis C.* Lemm.).

The *P. assymetricum* was found sparingly in the sample.

**P. conicum** (Gran) Ostenfeld et Schmidt, l. c., 1901, p. 174.

Specimens agreeing well with the figures of *P. conicum* (Gran, Rep. Norweg. Fisheries and Mar. Invest., vol. 2, No. 5, 1902, fig. 14) were found in the sample.

**P. crassipes** Kofoid, Univ. Calif. Publ. Zoology, III, 1907, p. 309, tab. 31, figs. 46—47.

I have taken one of Dr. Justesen's drawings as belonging to *P. crassipes*.

**P. depressum** Bailey, Smithsonian Contrib. to Knowledge, VII, Washington, 1855, p. 12, figs. 13—14.

Seems to be common in the Boeton Strait. Dr. Justesen has made several drawings of it and I have found it in the sample. Probably several forms are included under this name.

**P. divergens** Ehbg.; Paulsen, Medd. Komm. f. Havundersøg., Ser. Plankton, I, No. 5, 1907, p. 16, fig. 23; *P. speciosum* Jørgensen, l. c., 1912, p. 8.

Both drawn by Dr. Justesen and found by me in the sample. Seems to be common in the Boeton Strait.

**P. grande** Kofoid, Bull. Mus. comparat. Zoology at Harvard College, vol. 50, No. 6, 1907, p. 174, pl. 5, fig. 28.

A drawing by Dr. Justesen seems to agree well with Kofoid's figure.

**P. oblongum** (Aurivillius) Cleve, K. Svenska Vetensk. Akad. Handl., Bd. 32, No. 8, 1900, p. 20.

I agree with Jørgensen (l. c., 1912, p. 6) in keeping *P. oblongum* distinct from *P. oceanicum*. The drawing made by Dr. Justesen was very like that by Schütt, Peridineen d. Plankton Exp., 1895, Pl. 13, fig. 44.

**P. oceanicum** Vanhöffen, Grönl. Exp. d. Ges. für Erdkunde, Berlin, Bd. II, Teil 1, 1897, tab. 5, fig. 2; *P. elegans* Cleve, K. Svenska Vetensk. Akad. Handl. Bd. 34, No. 1, 1900, p. 16, pl. 7, figs. 15, 16.

To this species I refer the very flat, long-horned form which I have drawn from a specimen found in the sample (Fig. 1); it was 150 μ long and 110 μ broad.

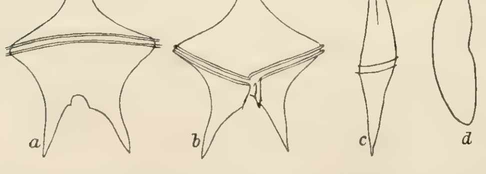


Fig. 1. *Peridinium oceanicum* Vanhöff., a form from the Boeton Strait. *a*, dorsal view; *b*, ventral view; *c*, side view; *d*, apical view. ($\frac{200}{1}$).

**P. pentagonum** Gran, Rep. Norweg. Fisheries and Mar. Invest., vol. 2, No. 5. 1902, p. 190, fig. 15.

With this species I have identified one of Justesen's

drawings. *P. latissimum* Kofoid (Bull. Mus. comparat. Zoology at Harvard Coll., vol. 50, No. 6, 1907, p. 175, pl. 5, figs. 31, 32) seems very near to it (perhaps identical), the outline being the same in the two species; but the tabulations of the epitheca are different.

**P. pellucidum** (Bergh) Schütt, Die Peridineen der Plankt. Exped., 1895, p. 157; *Protoperidinium p.* Bergh, l. c., 1881, p. 227, figs. 46—48. Found in the sample.

**P. pyriforme** Paulsen, Peridineen, in Nord. Plankton, 1908, p. 46, fig. 57.

Some of Dr. Justesen's drawings must be referred to this species, others are more doubtful.

**P. quarnerense** (B. Schröd.) Broch, Arch. f. Protistenkunde, *20*, 1910, p. 183, fig. 3.

A species which answers to the drawings by Broch (l. c.) and to Stein's fig. 8 (tab. 9) of his *P. globulus*, was found in the sample.

**P. Steinii** Jørgensen, Bergens Museums Aarbog 1899, No. VI, p. 38.

Specimens referable to subsp. *mediterraneum* Kofoid (Arch. f. Protistenkunde, *16*, 1909, pl. 2, figs. 1—11) were found in the sample.

**Phalacroma porodictyum** Stein, 1883, l. c., tab. 18, figs. 11—14. Found in the sample.

**Podolampas bipes** Stein, l. c., tab. 8, figs. 6—8.

Drawn by Dr. Justesen.

**Prorocentrum micans** Ehrenberg, Abhandl. d. Berlin. Akad., 1833, p. 307; Stein, l. c., 1883, tab. 1, figs. 1—3, 12.

Found in the sample.

**Pyrophacus horologicum** Stein, l. c., tab. 24. Both found in the sample and drawn by Dr. Justesen.

## IV. Bacillariaceæ (Diatoms).

**Actinocyclus Ehrenbergii** Ralfs, in Pritchard, Infusoria, p. 834; Van Heurck, Synopsis, 1880—81, p. 215, tab. 123, fig. 7.

Common in the sample in numerous forms, some answering to the figure quoted, others to the figure of *A. Ralfsii* (W. Sm.) Ralfs (Van Heurck, l. c., fig. 6), the main part being in characters somewhere between the two forms which can not be kept as two species.

**A. subtilis** (Greg.) Ralfs, l. c., p. 835; Van Heurck, l. c., p. 216, tab. 124, fig. 7.

Found in the sample, but it seems doubtful if this form is really distinct from the foregoing species.

**Asterionella notata** Grun., in Van Heurck, l. c., tab. 52, fig. 3; Cleve, K. Svenska Vetensk. Akad. Handl., *34*, No. 1, 1900, p. 19, pl. 7, fig. 32.

Dr. Justesen has drawn an excellent figure of a chain of this little known species; it (fig. 2) shows the numerous small chromatophores.

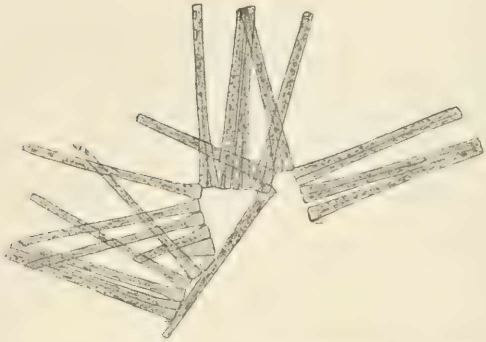

Fig. 2. *Asterionella notata* Grun., a chain showing its twisted appearance. (Drawn by Dr. Justesen).

**Asteromphalus heptactis** (Bréb.) Ralfs, l. c., p. 838, tab. 8, fig. 21; Gran, Diatomeen, in Nord. Plankton, 1905, p. 45, fig. 49.

Found in the sample.

**Bacteriastrum hyalinum** Lauder, Transact. Microscop. Soc., 1864, p. 8, pl. 3, fig. 7; Ostenfeld, Botan. Tidsskr., *25*, 1902, p. 232, fig. 9.

Some of Dr. Justesen's drawings seem to be this species. I reproduce one of them (fig. 3) to show the chain imbedded in a mucilage and the numerous small chromatophores. With regard to the awns (setæ) the drawing is rather insufficient.

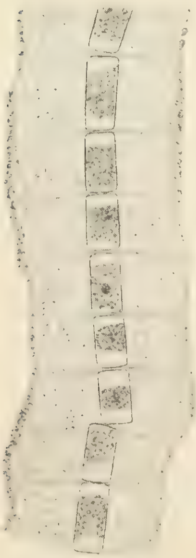

Fig. 3. *Bacteriastrum hyalinum* Laud., a chain imbedded in mucilage. (Drawn by Dr. Justesen.)

**B. varians** Lauder, l. c., p. 8, pl. 3, fig. 1—6. Seems to be common in the plankton of the Boeton Strait, and very varying. One of the drawings answers well to var. *hispida* (Castracane) B. Schroeder, Vierteljahrsschr. Naturf. Ges. Zürich, *51*, 1906, p. 347, fig. 11.

**Biddulphia mobiliensis** (Bail.) Grunow, in Van Heurck, l. c., tab. 101, figs. 4—6; Boyer, Proc. Acad. Nat. Sc. Philadelphia, 1900, p. 698; Ostenfeld, Medd. Komm. Havundersøg., Ser. Plankton I, No. 6, 1908, p. 7, fig. 2.

Seems to be rare in the Boeton Strait.

**B. sinensis** Greville, Transact. Microsc. Soc., London, 1866, pl. 9, fig. 9; Ostenfeld, l. c., 1908, fig. 1.

Very common according to the many figures drawn by Dr. Justesen. I reproduce one of them (fig. 4) to show a very large cell, most probably an initial cell from an auxospore.

Besides the two plankton forms, several other species of *Biddulphia* were present in the sample or amongst the drawings, e. g. *B. vesiculosa* (Agardh) Boyer and *B. tridens* Ehbg.

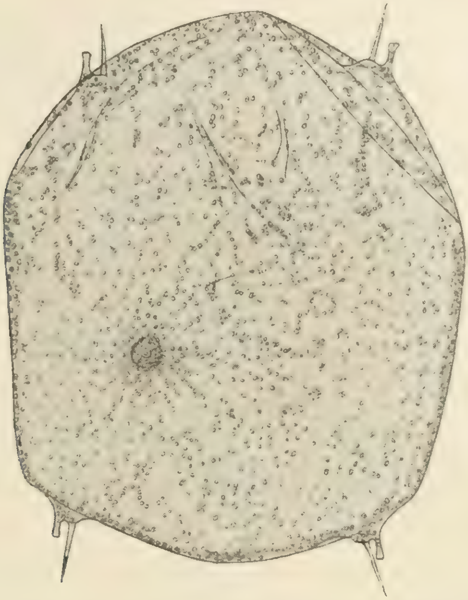

Fig. 4. *Biddulphia sinensis* Grev., a very large cell, probably the cell which comes from the auxospore. (Drawn by Dr. Justesen.)

**Chaetoceras coarctatum** Lauder, Trans. Microc. Soc., London, 1864, p. 79, pl. 8, fig. 8; Cleve, Bih. Sv. Vetensk. Akad. Handl., Bd. 1, No. 11, 1873, p. 9, pl. 2, fig. 10; G. Karsten, Deutsche Tiefsee Exp. 1898–99, Bd. 2, Teil 2, 1906, p. 166, pl. 31, fig. 3.

Common in the plankton of Boeton Strait, both found in the sample and drawn by Dr. Justesen.

**Ch. compressum** Lauder, l. c., 1864, p. 78, pl. 8, fig. 6; Cleve, l. c., 1873, pl. 8.

Drawn by Dr. Justesen.

**Ch. didymum** Ehbg.; Cleve, Bih. Sv. Vetensk. Akad. Handl., Bd. 20, III, No. 2, 1894, p. 13, pl. 1, figs. 3–4; Gran, Diatom. in Nord. Plankton, 1905, p. 79.

As the foregoing.

**Ch. diversum** Cleve, l. c., 1873, p. 9, pl. 2, fig. 12; Gran, l. c., 1905, p. 87.

As the foregoing.

**Ch. furca** Cleve, A Treatise of the Phytoplankton, Upsala, 1897, p. 21, pl. 1, fig. 10; Karsten, Deutsche Tiefsee Exp. 1898–99, Bd. 2. Teil 2, 1906, p. 169, pl. 32, fig. 13.

As the foregoing.

**Ch. Lauderi** Ralfs, in Lauder, l. c., 1864, p. 77, pl. 8, fig. 4; *Ch. Weissflogii* Schütt, Ber. Deutsch. bot. Ges., 1895, p. 44, fig. 17; Gran, l. c., 1905, p. 77.

As the foregoing.

**Ch. Lorenzianum** Grunow, Verhandl. k. k. zool.-botan. Ges. Wien, 1863, p. 157, pl. 14, fig. 13; Gran, l. c., 1905, p. 76.

Several of Dr. Justesen's drawings seem to represent this species which is perhaps only the tropical race of the northern *Ch. decipiens* Cleve.

**Ch. paradoxum** Cleve, l. c., 1873, p. 10, pl. 3, fig. 16.

Drawn by Dr. Justesen.

**Ch. peruvianum** Brightwell, Microsc. Journ., 1856, p. 107, pl. 7, fig. 16; Gran, l. c., 1905, p. 70.

Drawn by Dr. Justesen and not rare in the sample.

**Ch. polygonum** Schütt, Ber. Deutsch. Bot. Ges., 1895, p. 46; *Ch. pol., forma* Schroeder, Vierteljahrsschr. Naturf. Ges. Zürich, Jahrg. *51*, 1906, p. 348, fig. 8.

A form agreeing well with Schroeder's figure was drawn by Dr. Justesen.

**Ch. Schmidtii** Ostenfeld, Vid. Medd. Naturh. Forening, København, 1901, p. 155, fig. 8.

Several drawings are very like the species which I have described from the Red Sea and the Gulf of Siam.

**Ch. secundum** Cleve, l. c., 1873, p. 10, pl. 2, fig. 14; *Ch. curvisetum* Cleve, in Kanonbaaden Hauchs Togter, Kjøbenhavn 1889, p. 55 with fig.; Gran, l. c., 1905, p. 91.

Drawn by Dr. Justesen.

**Ch. tetrastichon** Cleve, A Treatise of Phytoplankton, 1897, p. 22, pl. 1, fig. 7.

As the foregoing.

**Ch. Vanheurckii** Gran, Norske Nordhavs Exp., Protophyta, 1897, p. 18; Ostenfeld, Botan. Tidsskr., *25*, 1902, p. 240, figs. 18—19.

As the foregoing.

**Corethron criophilum** Castracane, Challenger Rep., 1886, p. 85, pl. 21, figs. 12, 14, 15; *C. hystrix* Hensen, V. Ber. Kommiss. in Kiel, 1887, p. 89, pl. 5, fig. 49; *C. pelagicum* Brun, Mém. soc. de phys. et d'hist. nat. Genève, vol. 31, pt. II, no. 1, tab. 19, fig. 6; B. Schroeder, l. c., p. 343, fig. 3.

Two drawings by Dr. Justesen have been referred to this widely distributed species. —

None of the drawings of *Coscinodiscus*-forms showed any structure of the valves, they were therefore quite useless. But this drawback was much diminished, as the sample contained several *Coscinodisci* which could be referred to species, only the larger ones being broken to pieces.

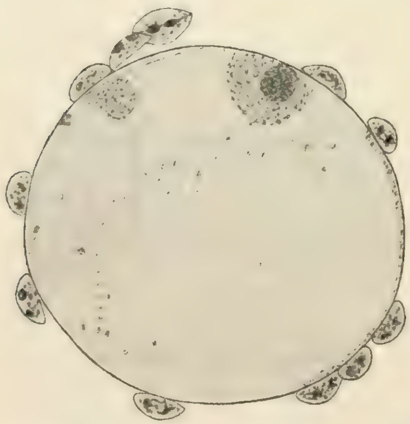

Fig. 5. *Coscinodiscus* sp. with many small *Cocconeis* sp. attached to the girdle. (Drawn by Dr. Justesen).

Amongst the drawings were two showing how the *Coscinodisci* are used as hosts for smaller diatoms. I reproduce one of them (fig. 5): The *Coscinodiscus* wears 11 individuals of *Cocconeis* sp. around the girdle.

**Coscinodiscus Castracanei** nom. nov.; *C. centralis* var. nov., Castracane, Challenger Rep, 1886, p. 155, pl. 2, fig. 3; ? *C. oculus iridis* Ostenfeld, Botan. Tidsskr., 25, 1902, p. 222; non *C. centralis* Ehbg., nec *C. oculus iridis* Ehbg.

*Diam. ca. 200 μ; valvæ planæ; rosula centralis obvia; areoli sat magni, radiati; apiculi marginales desunt; copula annulata dense striata. Chromatophora haud numerosa, parva.*

This species is easily known when seen from the girdle, which is densely and finely striate. The valve has about the same structure as that of *C. oculus iridis*, but is quite flat (fig. 6).

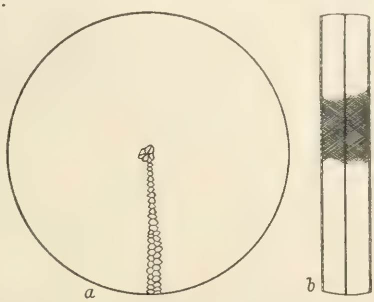

Fig. 6. *Coscinodiscus Castracanei* nom. nov. *a*, valvar view; *b*, girdle view. ($\frac{200}{1}$).

As my specimens agree well with the form figured by Castracane as »*C. centralis* var. nov.«, I have named it *C. Castracanei*. It differs from the true *C. centralis* by the absence of any apiculi at the margin and by the flat valves, and does not at all belong to the same group, that which I have called *Biapiculati*.

**C. Janischii** A. Schmidt, Atl. d. Diatomaceenkunde, Pl. 64, figs. 3—4; *C. arafurensis* var. nov., Castracane, l. c., p. 153, pl. 2, fig. 4; *C. craspedodiscus* Castracane, ibid., pl. 3, fig. 5.

Fragments of this large species were not rare in the sample.

**C. Jonesianus** (Grev.) nob.; *Eupodiscus Jonesianus* Greville, Trans. Microsc. Soc., 1862, p. 22, pl. 2, fig. 3; *E.* ? *commutatus* Grunow, Denkschr. Wien. Akad. math. Nat. Kl., 1884, p. 79, ex minima parte; *Cosc. radiatus*, var. *Jonesianus* Van Heurck, Treatise Diatom., 1896, p. 531, ex minima parte; ? *Coscinodiscus* sp. A. Schmidt, l. c., pl. 60, fig. 16.

*Diam. 200—280 μ; valvæ plano-convexæ; rosula centralis ex areolis majusculis efformata; areoli ceteri sat delicati fere ut in C. Granii Gough; series rectæ, ± fasciculatæ; apiculi numerosi submarginales uniseriati delicati, duo autem magni, conici, cavi, fere ut in C. commutato Grun.; apiculi non pauci, delicatissimi in orbem irregularem fere dimidium inter centrum et marginem ducti; copula regulari (non obliqua), ca. 50—60 μ lata. Chromatophora numerosa, sat magna.*

In a paper on the phytoplankton of the Aral Sea (Wiss. Ergebn. Aralsee-Exp., Lief. VIII, Isw. d. Turkest. Abt. d. k. Russ. Geogr. Gesellsch. IV, St. Petersburg 1908) I have created the group *Biapiculati* for those *Coscinodiscus* species which have: a radiate arrangement of the areoles with some larger ones in the centre, a single row of small apiculi near the margin of the valve and two larger apiculi in this row, the angle between those two being larger than 90°, smaller than 180°. To this group were referred: *C. Granii* Gough, *C. ara-*

*lensis* Ostf., *C. biconicus* Van Breemen, *C. centralis* Ehbg. and *C. concinnus* Ehbg. Another species belonging hereto was rather common in Dr. Justesen's sample (fig. 7). On closer examination of the older literature I found that it could be identified with *Eupodiscus Jonesianus* Greville; at the same time it became evident that *C. biconicus* Van Breemen was the same as *Eupodiscus ? vel Coscinodiscus commutatus* Grunow (l. c., p. 79).


Fig. 7. *Coscinodiscus Jonesianus* (Grev.) nob., *a*, valvar view showing the position of two big processes, the small submarginal apiculi, the very small apiculi halfway to the centre and the central rosette of areoles; *b*, valvar view showing a sector with chromatophores and the nucleus. ($\frac{200}{1}$).

Greville's description of his *Eupodiscus Jonesianus* (l. c., p. 22) is not very good, but on comparing it with the figure, no doubt remains that we have here a *Coscinodiscus*, as also Van Heurck (l. c.) has pointed out. The figure shows three large apiculi (processes) instead of two, but it is probably an error in drawing. Greville says that the structure is »minute«, and that »the puncta in the centre of the disc are rather larger than the rest.« This makes it difficult to identify his species with Grunow's *C. commutatus* as Van Heurck (l. c.) and Rattray (Proc. Roy. Soc. Edinburgh, *16*, 1888—89, p. 84) have done. Grunow (l. c.) says: »Mit *C. concinnus* hängt eine bisher verwechselte und übersehene, nicht seltene Art zusammen, welche ich *Eupodiscus ? commutatus* genannt habe, welche aber vielleicht besser bei *Coscinodiscus* bleibt. Sie kommt bei Cuxhafen, Brasilien, China, Java und im Peru Guano vor und hat zwei kleine marginale Anhängsel . . Die kleinen Anhängsel von *C. commutatus* stehen nicht diametral gegenüber. Am Rande stehen kurze Stacheln, von denen, wie bei *C. concinnus*, kurze, oft schwer sichtbare Radien nach innen gehen,« He quotes A. Schmidt, Atlas, pl. 60, fig. 16, which represents a specimen from Peru Guano, but which is fragmentary and unsatisfactory. Quite recently we have got an excellent photograph of the Cuxhaven *C. commutatus* in a paper by Chr. Brockmann (Brackwasserstudien, in Schriften des Vereins für Naturk. an der Unterweser IV, Geestemünde, 1914, p. 43, fig. 5). From this it becomes evident that it is the same species as that described as *C. biconicus* by Van Breemen (Plankton van Noordzee en Zuiderzee. Leiden 1905, p. 23, cfr. Ostenfeld, Aral Sea, p. 148, pl. 6, figs. 1—3) from the Zuyder Zee.

This species is closely related to that from our sample, but it differs in the much coarser structure and in the absence of the very small apiculi halfway between the margin and the centre. Therefore

*C. commutatus* Grun., as far as the North Sea form is concerned, is not identical with *C. Jonesianus* (Grev.) (but it is probable that GRUNOW has included both under the one name). Now it seems to me convenient to keep *Greville's* name for the tropical form with the »minute« structure (GREVILLE's specimen came from a »guano; locality unknown«) and GRUNOW's for the North Sea form. The synonymy of the first is given above, that of the last is as follows: *C. commutatus* Grun., Denkschr. Wien. Akad., 1884, p. 79, ex maxima parte; Brockmann, l. c., 1914, p. 43, fig. 5; *C. concinnus*, var. *Jonesianus* Van Heurck, Treatise Diatomac., 1896, p. 531, ex maxima parte; *C. biconicus* Van Breemen, l. c., 1905, p. 23, fig. 5; Ostenfeld, l. c., p. 148, pl. 6, figs. 1—3.

In a Key to identify the species of the *Biapiculati* which I have published in the above quoted paper (1908, p. 148) the section B a (which contained only *C. biconicus*) has to be altered thus:

B. Girdle band equally broad everywhere.
  a. The two asymmetrical apiculi very large.
    α, structure coarse; cell medium sized. *C. commutatus* Grun.
    β, structure fine; cell large. *C. Jonesianus* (Grev.) nob.

The chromatophores of *C. Jonesianus* are numerous and rather large, as seen in my figure (Fig. 7). The angle between the two large apiculi is about 100°.

**C. radiatus** Ehbg., Abhandl. Berl. Akad., 1839, p. 148, pl. 3, fig. 1.

Under this collective name I place some rather small coarsely areolated *Coscinodisci* which were not rare in the sample.

**C. Rothii** (Ehbg.) Grunow, Denkschr. Wien Akad., 1884, p. 29, tab. 3, fig. 20.

A rather small *Coscinodiscus* species (ca. 90 μ), which agreed well with GRUNOW's figure, was found rarely in the sample.

**C. undulans** Rattray, l. c., p. 104; *C. undulatus* Castracane, Challenger Rep., p. 159, tab. 8, fig. 3; non *C. undulatus* Cleve.

Fragments of a large species with undulated valves and very large areoles were not rare in the sample. It seems to agree well with CASTRACANES's above quoted figure of his new species, which came from the Pacific.

**Detonula Moseleyana** (Castr.) Gran, Nyt Magaz. Naturv. 1900, p. 113; *Lauderia? Moseleyana* Castracane, l. c., p. 90, pl. 24, fig. 9.

Drawn by Dr. Justesen.

**D. Schroederi** (Bergon) Gran, Diatom. in Nord. Plankton, 1905, p. 22; *Lauderia Schroederi* Bergon, Soc. scientif. d'Arcachon, Stat. biolog., 6e année, 1902, p. 69, pl. 1, figs. 11—15; B. Schroeder, Vierteljahrsschr. Naturf. Ges. Zürich, *51*, 1906, p. 344, fig. 4; G. Karsten, Deutsche Tiefsee Exp. 1898—99, Bd. 2, Teil 2, 1906, p. 375, pl. 41, fig. 10.

Drawn by Dr. Justesen.

To this species I think it better to refer the *Detonula* from the Gulf of Siam which in my report (Bot. Tidsskr., 25, 1902, p. 225) I have called *D. delicatula* (Perag.) Gran.

**Ditylium sol** (Van Heurck) De Toni, Sylloge Algar., 1894, p. 1018; B. Schroeder, l. c., p. 355, fig. 23; *Triceratium sol* Van Heurck, Synopsis, pl. 115, figs. 1—2.

Drawn by Dr. Justesen.

**D. trigonum** B. Schroeder, Vierteljahrsschr. Naturf. Gesch. Zürich, *51*, 1906, p. 356, fig. 25.

One of Dr. Justesen's drawings (Fig. 8) agrees well with the description and figure of *D. trigonum*; but I am not convinced that it is an independent species, more probably only a form of the foregoing species.

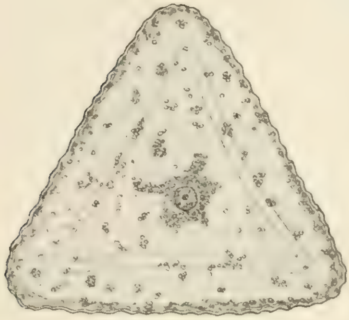

Fig. 8. *Ditylium trigonum* B. Schroed., valvar view. (Drawn by Dr. Justesen.)

**Eucampia biconcava** (Cleve) Ostenfeld, Bot. Tidsskr., *25*, 1902, p. 241, *E. hemiauloides* Ostenfeld, Vid. Medd. Naturh. For., København, 1901, p. 157, fig. 9; *Climacodium biconcavum* Cleve; A Treatise of Phytoplankton, 1897, p. 22, pl. 2, figs. 16—17.

Dr. Justesen has made several drawings of this tropical species.

**E. zodiacus** Ehbg., Kreideth., p. 71, pl. 4, fig. 8; Gran, Diatom., in Nord-Plankton, 1905, p. 98, fig. 126.

Drawn by Dr. Justesen.

**Gossleriella tropica** Schütt, in De Toni, Sylloge Algar., 1894, p. 1424; Das Pflanzenleben der Hochsee, 1895, p. 20, fig. 7; G. Karsten, Deutsche Tiefsee-Exp. 1898—99, 1906, p. 368, pl. 40, fig. 14.

Dr. Justesen has made several nice drawings of this beautiful diatom.

**Hemiaulus sinensis** Greville, Ann. Magaz. Nat. Hist. *16*, p. 5, fig. 9, 1865; *H. Heibergi* Cleve, Bih. k. Svenska Vet. Akad. Handl. Bd. 1, 1873, No. 11, p. 6, pl. 1, fig. 6.

Several drawings of this species were present.

**Lauderia annulata** Cleve, l. c., 1873, p. 8, pl. 1, fig. 7; Gran, Nyt Magaz. Naturv., Kristiania, 1900, p. 109, pl. 9, figs. 1—4.

Drawn by Dr. Justesen.

**Lauderiopsis costata** Ostenfeld, Vid. Medd. Naturh. Forening, København, 1901, p. 158, fig. 10.

A drawing by Dr. Justesen (fig. 9) must be referred to this species.

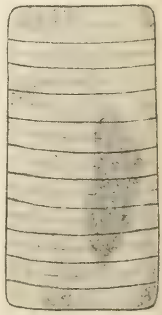

Fig. 9. *Lauderiopsis costata* Ostf.; girdle view. (Drawn by Dr. Justesen.)

**Navicula membranacea** Cleve, A Treatise of Phytoplankton, 1897, p. 24, pl. 2, fig. 25—28; Ostenfeld, Botan. Tidsskr., *25*, 1902, p. 245, fig. 23.

Several drawings of this species.

**Palmeria Hardmaniana** Grev.; Van Heurck, A Treatise of the Diatomaceæ, 1896, p. 538, f. 286; Ostenfeld, Botan. Tidsskr., *25*, 1902, p. 222, figs. 1—2. This interesting form was found in the sample and Dr. Justesen has made several drawings of it.

**Paralia sulcata** (Ehbg.) Cleve, Bih. Sv. Vet. Akad. Handl., Bd. 1, Nr. 13, 1873, p. 7; Gran, Diatom. in Nord. Plankton, 1905, p. 14, fig. 5.

Found sparingly in the sample.

**Planktoniella sol** (Wallich) Schütt, in De Toni, Sylloge Algar., 1894, p. 1424; Pflanzenleben der Hochsee, 1895, p. 20, fig. 8; Karsten, Deutsche Tiefsee Exp. 1898—99, Bd. II, Teil 2, 1907, p. 369, pl. 39, figs. 1—11.

Both found in the sample and also drawn by Dr. Justesen. —

Many of the drawings by Dr. Justesen showing forms of the genus *Rhizosolenia* are impossible to identify owing to the absence of any structure.

**Rhizosolenia alata** Brightwell, Quart. Journ. microsc. Sc., London, *6*, 1858, p. 96, tab. 5, fig. 7.

This widely distributed species was present in the sample in a long-beaked form. Amongst Dr. Justesen's drawings several are to be referred to this species, most of them belonging to the f. *indica* (Perag.) Ostenfeld (Vid. Medd. Naturh. Forening, København, 1901, p. 160; Botan. Tidsskr., *25*, p. 227, fig. 3). An interesting figure shows the auxospore formation; the auxospore represents the f. *indica*, the old cell is the typical form.

**Rh. amputata** Ostenfeld, Botan. Tidsskr., *25*, p. 227, fig. 4; Karsten, Deutsche Tiefsee Exp. 1898—99, Bd. II, 2. Teil, 1905—07., p. 376, pl. 42, fig. 2. Of this species, which seems to be an Indo-malayan form, Dr. Justesen has made three drawings.

**Rh. calcar-avis** Schultze, in Müll. Archiv, 1858, p. 339, pl. 13 figs. 5—10; Gran, Diatom., in Nord. Plankton, 1905, p. 54, fig. 66.

The same circumstances as in *Rh. alata* here apply: most of the drawings represent the large tropical form, f. *cochlea* (Brun) Ostenfeld (Botan. Tidsskr., *25*, p. 228, fig. 5), some are intermediate and others again are like the typical form; further the auxospore formation (in the same manner as that of *R. alata*) shows an auxospore part which is f. *cochlea* and a remainder which is the type.

**Rh. crassispina** B. Schroeder, Vierteljahrsschr. Naturf. Ges. Zürich, *51*, 1906, p. 345, fig. 5.

Some drawings (Fig. 10) show that this interesting species, which was hitherto known from Asiatic coastal waters of the Pacific, also occurs in the Boeton Strait. B. Schroeder suggests (l. c.) that it should perhaps be referred to *Rh. hebetata* Bail. as a variety, but it seems to me very different from that species. On the other hand, the structure is still unknown, and the place within the genus therefore uncertain.

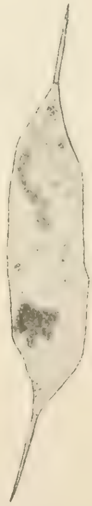

Fig. 10. *Rhizosolenia crassispina* B. Schroed.; girdle wiew (Drawn by Dr. Justesen).

**Rh. imbricata** Brightwell, l. c., 1858, p. 95, pl. 5, fig. 6; H. Peragallo, Monogr. Rhizosol., p. 113, pl. 5, figs. 2—3.

Drawn several times by Dr. Justesen.

**Rh. robusta** Norman, in Pritchard, Infus. 1861, p. 866, pl. 8, fig. 42; Peragallo, l. c., p. 109, pl. 2, fig. 1, pl. 3, figs. 1—2; Karsten, Deutsche Tiefsee Exp. 1898—99, Bd. 2, 2, p. 163, 1906, pl. 29, fig. 10.

Numerous drawings of this characteristic species were made.

**Rh. setigera** Brightwell, l. c., 1858, p. 95, pl. 5, fig. 7; Gran, Diatom. in Nord. Plankton, 1905, p. 53, fig. 64.

Drawn by Dr. Justesen and also found by me in the sample.

**Rh. Stolterfothii** H. Peragallo, Diatom. de Villefranche, 1888, p. 90, pl. 6, fig. 44; Gran, l. c., p. 49, fig. 55.

Drawn by Dr. Justesen.

**Rh. styliformis** Brightwell, Quart. Journ. microsc. Sc., *6*, 1858, p. 96, pl. 5, fig. 5; Peragallo, Monographie Rhiz., p. 111, pl. 4, figs. 1—5.

Both the type and the large tropical form, f. *latissima* Btw. (l. c., fig. 5 c), were represented amongst the drawings.

**Roperia tesselata** (Roper) Grun., in Van Heurck, Synopsis, 1885, pl. 118, fig. 6; *Eupodiscus tesselatus* Roper, Quart. Journ. Microsc. Sc., *6*, 1858, p. 19, pl. 3, fig. 1.

Found in the sample.

**Stephanopyxis Palmeriana** (Grev.) Grunow, Denksch. Akad. Wien, 1884, p. 38; Otto Müller, Ber. deutsch. Bot. Ges., 1901, *19*, p. 196, fig. 1; *Creswellia P.* Greville, Transact. Microsc. Sc., 1865, p. 2, pl. 1, fig. 9.

Common in the Boeton Strait, to judge from the many drawings.

**S. turris** (Grev.) Ralfs, in Pritchard, Infus., 1861, p. 826, pl. 5, fig. 74; Gran, Diat. in Nordisches Plankton, 1905, p. 14, fig. 6.

Drawn by Dr. Justesen.

**Streptotheca thamensis** Cleve, in Shrubsole, Journ. Quekett Microsc Club, 1890, N. S., *4*, p. 259, pl. 13, fig. 4—6; *S. maxima* Cleve, Kgl. Svenska Vet. Akad. Handl., *35*, Nr. 5, 1901, p. 57, pl. 8, fig. 5; *S. indica* Karsten, Deutsche Tiefsee Exp. 1898—99, Bd. 2, Teil 2, 1907, p. 395, pl. 46, fig. 8.

Amongst Dr. Justesen's drawings both the typical *S. thamensis* and the large tropical form (*S. maxima*) are found, thus showing the identity of the two species.

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Bd. 2 • DANSK BOTANISK ARKIV • Nr. 5
UDGIVET AF DANSK BOTANISK FORENING
1916

# Bidrag til Danmarks Svampeflora.

## I.

Af **Ove Rostrup.**

(Med Tavle I—III).

I J. Linds »Danish Fungi as represented in the herbarium of E. Rostrup« er optaget Størstedelen af mine mykologiske Fund indtil 1912. Hvad jeg dengang oversaa eller senere har faaet undersøgt og bestemt af tidligere Fund, samt hvad jeg siden har fundet, er nedenstaaende en Fortegnelse over. Foruden de for Landet ny Arter, der er forsynede med en *, har jeg anført Findesteder for en Del Arter, der i „Danish Fungi etc." kun er nævnt fra et eller nogle faa Findesteder, eller som jeg har fundet paa Værtplanter, paa hvilke de ikke tidligere er bemærkede. Af ny Arter er der beskrevet 19, der alle er forsynede med Afbildninger, ligesom jeg har afbildet en Del tidligere beskrevne Arter, af hvilke jeg har fundet afvigende Former eller Monstrositeter, eller som der ikke forelaa Figurer — eller kun mindre heldige Figurer — af.

## Oomycetes.

### Peronosporaceae.

**Cystopus candidus** Lév. Paa *Camelina linicola.* København.

**Cystopus cubicus** Lév. Paa *Tragopogon campestris* og *T. major.* Botanisk Have i København. *Cirsium oleraceum.* S. Bistrup, J. Urlev Skov.

**Plasmopara pusilla** (de By.) Schroet. Paa *Geranium silvaticum.* S. Boserup Skov.

**Peronospora violacea** Berk. Paa *Knautia arvensis.* S. Kirkelte Hegn.

### Synchytriaceae.

**Synchytrium aureum** Schroet. Paa *Cirsium palustre.* J. Nebsager.

**Synchytrium globosum** Schroet. Paa *Cirsium oleraceum.* S. Folehaven.

**Urophlyctis major** Schroet. Paa *Rumex acetosa.* J. Sæby.

# Zygomycetes.

## Mucoraceae.

***Mucor proliferus** Schostakow. Paa Hestegodning. S. Gelsskov 1915.

***Mucor plasmaticus** v. Tiegh. Paa Hestegodning. S. Kirkelte Hegn, Okt. 1915.

***Absidia glauca** Hagem. I Jorden. Møen: Borre 1913.

**Absidia orchidis** (Vuill.) Hagem. I Jorden. Møen: Borre.

**Pilobolus Kleinii** v. Tiegh. Paa Hestegodning. København.

## *Mortierellaceae.

***Mortierella candelabrum** v. Tiegh. et le Monn. Paa *Polyporus adustus*. S. Jægersborg Dyrehave. Paa raaddent Ved: S. Ravnsholt Hegn 1913.

***Mortierella polycephala** Coemans. Paa nedfaldne Naale og raaddent Ved af *Picea excelsa*. S. Bondernes Hegn, Folehaven, Giesegaard 1914.

***Mortierella simplex** v. Tiegh. et le Monn. Paa Ekskrementer af *Meles taxus*. S. Gelsskov, Aug. 1915.

***Mortierella globulifera** n. sp. Hyphis sporangiferis caespitosis, continuis, simplicibus, basi incrassatis, $\frac{1}{2}$—1 mm altis, infra 24—28 $\mu$, supra

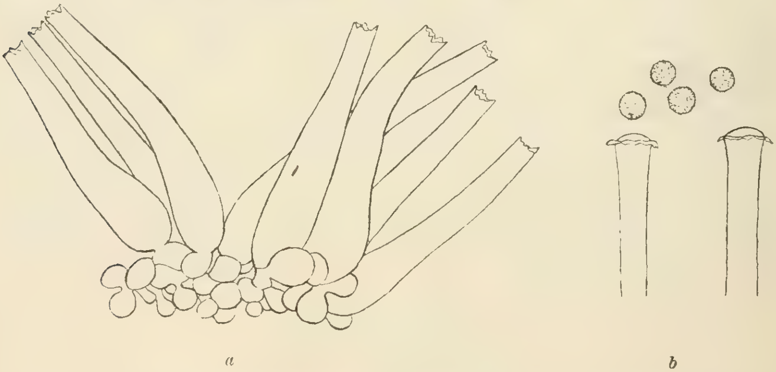

Fig. 1. *Mortierella globulifera*. *a*. Basis af Sporongiebærerne 260 : 1, *b*. Spidsen af 2 Sporangiebærere og Sporer 560 : 1.

4,5—5,5 $\mu$ crassis, basi vesiculis subglobosis, hyalinis instructis. Sporangiis globosis, albis, glabris, 40—48 $\mu$ diam. Sporis globosis, episporio tenuiter echinulato, 6—7 $\mu$ diam. (Fig. 1).

In fimo equino. S. Jægersborg Dyrehave, Juni 1913.

Af de hidtil beskrevne 28 *Mortierella*-Arter er *M. echinulata* Harz. den eneste, der har piggede Sporer, og *M. tuberosa* v. Tiegh. og *M. pilulifera* v. Tiegh. de eneste, der udmærker sig ved kugleformig opsvulmede Hyfer ved Grunden af Sporangiebærerne, men Protoplasmaet i disse er her meget mørkt farvet.

## Cephalidaceae.

***Piptocephalis microcephala** v. Tiegh. Paa *Mucor sp.* paa Ræveekskrementer. S. Gelsskov 1914.

***Piptocephalis fusispora** v. Tiegh. Paa *Mucor sp.* København 1914. S. Ermelunden.

***Chaetocladium Brefeldii** v. Tiegh. et le Monn. Paa *Mucor sp.* paa Ræveekskrementer. S. Gelsskov 1914.

## Entomophthoraceae.

**Empusa muscae** Cohn. Denne paa Stuefluer saa almindelige Art har jeg samlet paa følgende andre Fluer, der — ligesom de i det følgende nævnte Fluearter — velvilligst er bestemt af Museumsinspector W. Lundbeck, hvorfor jeg herved bringer ham min bedste Tak.

Paa *Hylemyia cardui*. J. Borris.
- — *coarctata*. J. Tylstrup.
- *Hyetodesia variabilis*. S. Boserup Skov.
- *Melanostoma mellinum*. Amager Fælled.
- *Melanostoma scalare*. S. Tokkekøb Hegn.
- *Scatophaga squalida*. København.
- — *stercoraria*. S. Tystofte, Jægersborg Hegn.

Medens alle disse er samlede i Juli—Oktober Maaneder, kan jeg meddele, at Lærer Kay Petersen i Aarhus allerede i April Maaned paa *Scatophaga stercoraria* fandt »en forbavsende Mængde Fluer, der dels var døde af Flueskimmelsvamp og dels var i Færd med at dø deraf« (Brev af 25. April 1914).

**Empusa grylli** (Fres.) Nowak. *Stenobothrus bicolor*. S. Uggeløse. Epidemisk paa Cikader (*Liburnia obscurella*), der sad paa Undersiden af Blade af Lysimachia vulgaris og Comarum palustre paa en lille Skoveng. S. St. Hareskov.

Konidierne 36—41 × 31—38 $\mu$.

***Empusa sciarae** Edgar W. Olive. I stor Mængde paa smaa Myg (*Sciara sp.*), der udvikledes i henraadnende Frø og Filtrerpapir i et Spireapparat. København, Okt. 1897. (Fig. 2).

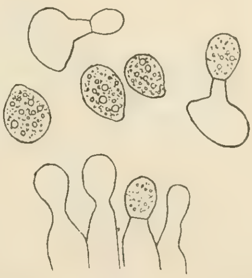

Fig. 2. *Empusa sciarae.* Konidier 400 : 1.

***Empusa Fresenii** Now. Paa Bedelus (*Aphis papaveris*), siddende paa blomstrende Runkelroer. Hvilesporerne fyldte Dyrene og gik endog ud i Følehorn og Ben (se Tav. I Fig. 1, der viser et Laar af en Bladlus,

indeholdende 31 saadanne Hvilesporer). S. Tune, Sept. 1912, Tystofte. (Fig. 3a).

**Entomophthora muscivora** Schroet. Denne Art, der ligesom *Empusa muscae* synes at være alm. paa Fluer, har jeg fundet paa følgende Arter:

*Leptis lineola.* S. Eskemosegaards Skov.

*Sapromyza rorida.* S. Rude Skov, Eskemosegaards Skov, Stenholt Vang.

*Lauxania aenea.* S. Lyngby.

*Sciomyza sp.* S. Boserup Skov.

*Tachydromya major.* S. Boserup Skov.

**Entomophthora tenthredinis** Fres. Paa Imago af en *Hemiteles sp.* (bestemt af Dr. I. C. NIELSEN). S. Jægersborg Hegn. Paa en Larve af *Pachyprotasis rapae.* S. Boserup Skov. Paa en ubestemmelig Bladhvepselarve. S. Ryget.

Konidierne 39—50(—62) × 29—34(—52) $\mu$.

Fig. 3. *a. Empusa Fresenii, b. Entomophthora aphidis.* Konidier 320 : 1.

**Entomophthora sphaerosperma** Fres. Paa *Tachydromia* (*flavicornis*?). S. Eskemosegaards Skov. I stor Mængde paa *Sapromyza rorida.* S. Folehaven. Paa en *Hemiteles sp.* (bestemt af Dr. I. C. NIELSEN). S. Jægersborg Hegn. Paa Imago af Kornsmælderen (*Agriotes lineatus*), samlet af Lærer KAY PETERSEN i Aarhus, der skriver: »Smælderne fandtes paa Hundegræstuer i Udkanten af en Havremark ved Marselisborg Slot. Der var i Regelen et Par Stykker paa hver større Tue«.

**Entomophthora aphidis** Hoffm. Paa *Aphis brassicae.* S. Lyngby. Paa *Aphis sp.* paa Jordbær. Langel. Tranekjær. (Fig. 3b).

**Entomophthora echinospora** Thaxt. Paa *Lauxania Elisae* (?). S. Lyngby. Paa en Myg. S. Rude Skov.

## *Basidiobolaceae.

***Basidiobolus ranarum** Eidam. Paa Ekskrementer af *Bufo vulgaris* og *Rana platyrrhinus.* S. Bure Sø, St. Hareskov, Juli 1913.

D. 10. Juli hjembragtes Frøen, d. 11. kvitteredes et Ekskrement, og allerede d. 13. fandtes der paa dette en rig Vegetation, saavel af Konidier som af Hvilesporer.

# Exoasci.

## Endomycetaceae.

***Eremascus albus** Eidam. Paa raadne Frugter af *Daucus carota* i Spireapparat. København, April 1889.

# Carpoasci.

## Gymnoascaceae.

***Gymnoascus Reesii** Baranetzky. Paa gamle Hundeekskrementer. Loll. Steensgaard, Juli 1900. Paa raadne Plantedele. København 1916.

***Arachniotus ruber** (v. Tiegh.) Schroet. I Jorden. S. Charlottenlund 1911.

***Arachniotus candidus** (Eidam) Schroet. Paa Ræveekskrementer. S. Gelsskov 1914.

Asci kuglerunde, $8\,\mu$ i Diam., eller bredt ovale, $8.5 \times 7\,\mu$.

**Myxotrichum brunneum** Rostr. Denne Svamp udfyldte fuldstændig en Puppe, der var dannet af en fra Glostrup modtaget *Amphidasys betularius*-Larve. Maj 1914.

**Ctenomyces serratus** Eidam. Paa henraadnende Kalkunfjer. S. Gelsskov, Aug. 1914.

## Aspergillaceae.

***Aspergillus nidulans** Eidam. Alm. paa henraadnende Frø i Spireapparater; paa fugtigt Bomuld og Kork. København.

***Aspergillus Amstelodami** (L. Magnin). Paa visne Blade af *Quercus robur*. S. Gelsskov 1911.

***Eurotium insigne** Wint. Paa henraadnende Straa og Blade af Græsser. S. Nygaard ved Damhussøen, Slangerup, Maj 1913.

Asci ægformede, $43 \times 34\,\mu$, Sporerne kugleformede, $10—12\,\mu$ i Diam.

Fig. 4. *Microascus sordidus*. En Cirrus 50 : 1.

**Anixiopsis stercoraria** Hans. Denne Svamp blev fundet i 1874 paa Ræveekskrementer i det sydvestlige Jylland af E. Chr. Hansen, der 21 Aar efter med sit gamle Materiale, der mærkelig nok havde holdt sig i Live saa længe, anstillede talrige Dyrkningsforsøg[1]), ved hvilke han bl. a. paaviste, at den havde en Konidieform. Siden synes Svampen ikke at være bemærket noget Steds, forend jeg i 1914 og 1915 genfandt den — ligeledes paa Ræveekskrementer og baade med Konidier og Perithecier. S. Gelsskov.

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[1]) Bot. Zeit. 1897, S. 127.

***Microascus sordidus** Zuk. Paa henraadnende Plantedele (Frugter af *Platanus occidentalis*, Blade af *Fagus silvatica*, sklerotiserede Bær af *Vaccinium myrtillus*). København, S. Gelsskov, Tokkekøb Hegn.

Meget karakteristiske er denne Svamps overordentlig lange, rodbrune Cirri. (Fig. 4)[1].

## Onygenaceae.

**Onygena equina** Fr. Paa Hestehove. S. Klosterris Hegn, Marts 1913. (Fig. 5a).

**Onygena corvina** Fr. Paa nogle i Efteraaret 1913 i Gelsskov udlagte Kalkunfjer fremkom i Aug. 1914 en Mængde smukt udviklede Exemplarer af nævnte Svamp. Sammen med disse Fjer var der tillige udlagt nogle under Sygdom affaldne Menneske-Taanegle, paa hvilke der ligeledes fremkom en Del *Onygena*; disse lignede habituelt mest *O. equina*, men deres Sporer og Sporesække stemmede ganske overens med Kalkunfjersvampens; begge havde Sporesække paa 9—11 × 7—8 $\mu$ og Sporer paa 6—7 × 3 $\mu$, medens Dimensionerne for en paa nøjagtig samme Sted i Aug. 1906 paa Hestehove fundet *O. equina* var følgende: Sporesække 14—17 × 10—12 $\mu$, Sporer 7—9 × 4—5 $\mu$. De Maal, der alm. angives for disse 2 Arter, er:


Fig. 5. *a. Onygena equina, b. O. corvina.* Sporesæk og Sporer. 860 : 1.

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[1]) Senere Tilføjelse: Ved at sammenligne Beskrivelsen og Figurerne i Emil Chr. Hansens »De danske Gjødningssvampe« (Vid. Medd. f. d. naturhist. For. i Kbhvn. 1876, S. 207) af den Svamp, som her beskrives under Navnet *Sphaerella Schumacheri*, med Zukals af *Microascus sordidus*, viser det sig at være samme Art, de har haft for sig. At denne intetsomhelst har at gøre med *Sphaerella* — *Mycosphaerella* — i den nu vedtagne Begrænsning af denne Slægt, er indlysende, og Saccardo har da ogsaa overført Hansens Svamp til Slægten *Rosellinia*; at den imidlertid heller ikke hører hjemme her, viser Zukals udførlige Beskrivelse. Men Svampens rette Navn maa da være *Microascus Schumacheri* (Hans.)!

Jeg benytter Lejligheden til at gøre opmærksom paa et Par mindre nøjagtige Udtryk i Saccardos Oversættelse af Hansens Beskrivelse (Syll. I, 276). Han siger om Asci »oblongo-ovatis, subsessilibus«, medens det hos Hansen hedder »omvendt ægformede, siddende« og i det franske Resumé »sessiles, obovales«, og om Sporernes Farve har Saccardo »olivaceo-brunneis«, medens Hansen skriver »gulbrune, gennemsigtige«, »jaunes brunes, transparentes«.

*O. equina*: Sporesække 16—24 × 12—16 μ, Sporer 5—9 × 4—6 μ.
*O. corvina*: — 8—10 × 7— 8 μ, — 5—8 × 2—3 μ.

Der er herefter næppe nogen Tvivl om, at det er *O. corvina*, der fandtes paa Menneskeneglene (Fig. 5b).

## Erysiphaceae.

**Phyllactinia guttata** (Fr.) Lév. Paa en Vandring gennem Ermelunden kort efter Løvfald i 1913 overraskedes jeg allerede i nogen Afstand fra en stor Bøg ved at se Bladene under denne hvidfarvede, som om de var besat med Rim. Ved nærmere Eftersyn viste Aarsagen sig at være den, at et meget stort Procenttal af Bladene var besat med *Phyllactinia guttata*, der dækkede hele eller Størstedelen af Bladenes Underside. Trods grundig Undersøgelse under talrige andre Træer rundt om i Ermelunden og den tilstødende Del af Dyrehaven fandt jeg ikke et eneste Blad med samme Svamp. Ogsaa i 1914 fandt jeg under det nævnte Træ — og kun der — talrige angrebne Blade, men dog langtfra i saadan Mængde som i 1913. Men hvad kan Grunden være til, at kun dette ene Træ bliver saa stærkt befængt?

**Uncinula bicornis** (Fr.) Lév. Denne Arts Oidieform (*Oidium aceris* Rbh.) angives (f. Ex. af Lindau) at have Oidier paa 25—45 × 8—12 μ, altsaa c. 3½ Gang saa lange som brede. Ved at maale en stor Del Oidier fra Blade af *Acer pseudoplatanus* (Kbhvn. Aug. 1914) fandt jeg imidlertid et ganske andet Forhold mellem Længde og Bredde. Maalene var: 27—42 × 15—20 μ, og det nøjagtige Gennemsnit 33.3 × 16.7 μ, altsaa Oidier, der kun var dobbelt saa lange som brede. Og endnu tykkere — i Forhold til Længden — fandt jeg Oidierne paa Blade af *Acer campestre* (Langel. Carlseje, Aug. 1903) nemlig: 24—37 × 14—18 μ, i Gennemsnit 27.7 × 16.8 μ.

**Uncinula necator** (Schw.) Burr. Ogsaa denne Arts Oidier (*Oidium Tuckeri* Berk.) har jeg fundet betydelig større, end jeg har set angivet i Literaturen. Medens saaledes Schroeter og Lindau begge skriver 25—30 × 15—17 μ (G. Winter har endog 8 × 5 μ), har jeg ved Maalinger af en Mængde Oidier (Ellingegaard, Aug. 1913) fundet Dimensionerne: 30—44 × 18—23 μ, i Gennemsnit 37 × 21 μ.

## Hypocreaceae.

**Hypomyces aurantius** (Fr.) Tul. Paa *Polyporus varius*. S. Klosterris Hegn, Marts 1913.

***Melanospora leucotricha** Cda. Tem. alm. paa døde Frø i Spireapparater hele Aaret rundt. København. Paa henraadnende Grene. S. Rude Skov, Okt. 1913.

***Melanospora vervecina** (Desm.) Fckl. Paa visne Blade af *Quercus robur*. S. Gelsskov 1911.

***Melanospora Townei** Griff. Paa henraadnende Naale af *Picea excelsa*. S. Gelsskov 1914.

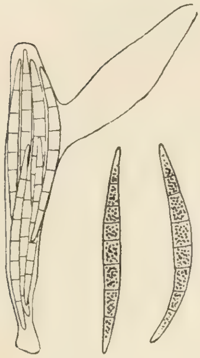

Fig. 6. *Calonectria belonospora*. En Dobbeltascus og Sporer 560 : 1.

***Nectriella charticola** Fckl. Paa henraadnende Pap. S. Bøndernes Hegn, Okt. 1913.

***Nectriella paludosa** Fckl. Paa meget fugtigt liggende Straa af *Avena sativa*. S. Lundby, Aug. 1913. Sporerne 13—15 × 5—6 $\mu$.

**Nectria episphaeria** Fr. Paa *Xylaria polymorpha*. S. Ermelunden, Nov. 1914. Paa *Cytospora pinastri* paa Naale af Abies alba (1—4 Perithecier paa hver *Cytospora*-Pyknide). S. Gelsskov, April 1915.

**Nectria sanguinea** Fr. Paa nedfaldne Frugter af *Crataegus oxyacantha*. S. Ermelunden.

***Calonectria belonospora** Schroet. Paa *Diatrype stigma*. S. Rude Skov, April 1914.

Fig. 6 viser et Par Sporer og en monstrøs Sporesæk. En ganske lignende »Doppelascus« har G. Moesz fundet hos *Dermatea carpinea*[1]).

Fig. 7. *Calonectria pellucida*. En Sporesæk 560 : 1.

***Calonectria pellucida** n. sp. Peritheciis superficialibus, perfecte sphaericis, pellucido-albis v. hyalinis, 140—150 $\mu$ diam., pariete 15 $\mu$ crasso. Ascis cylindraceis, breviter pedicellatis, saepe curvatis, 160—165 × 5 $\mu$. Sporis monostichis, fusoideis, utrinque acutissimis, 3—5 septis, qua vix in conspectum cadunt, instructis, guttulatis, 18—21 × 3.7—4.3 $\mu$. (Fig. 7).

Ad paleas *Dactylidis glomeratae*. S. Gelsskov, Marts 1912.

Kun én anden *Calonectria*-Art udmærker sig ogsaa ved hyaline Perithecier, nemlig *C. adianti* Rehm.

**Chromocrea gelatinosa** (Fr.) Seaver (= *Hypocrea g.*). Paa henraadnende Græsstraa. J. Sæby, Aug. 1893.

**Epichloë typhina** (Fr.) Tul. Paa *Poa pratensis*. S. Ørslev (P. Nielsen). Paa *Alopecurus geniculatus*. S. Præstevangen v. Hillerød.

**Claviceps nigricans** Tul. Paa *Scirpus paluster*. Amager Fælled, Aug. 1908.

**Claviceps purpurea** (Fr.) Tul. Paa *Avena pubescens*. S. Jægersborg Dyrehave. Paa *Festuca alopecurus*. Bot.

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1) Botanikai Közlemények 1911, S. 112.

Have i København. Paa *Andropogon bicornis.* S. Ørslev (P. Nielsen). Paa *Lagurus ovatus.* Bot. Have i København.

Over nogle Spiringsforsøg med Sklerotier af *Claviceps purpurea* giver hosstaaende 2 Tabeller en Oversigt. Sklerotierne var indsamlede i Løbet af Efteraaret 1913, hvorefter de blandede med Jord i smaa Urtepotter tilbragte Vinteren under aaben Himmel. I Marts Maaned toges de ind og udsaaedes i Petriskaale paa Filtrerpapir, der stadig holdtes fugtigt. Tab. 1 viser, hvorledes Spiringen forløb.

Tabel 1.

| Sklerotier fra | Antal Sklerotier, udsaat i Efteraaret 1913 | Spirede i Foraaret 1914 | Spirede i Foraaret 1915 | Døde |
|---|---|---|---|---|
| Secale cereale | 61 | 61 | — | — |
| Molinia coerulea | 37 | 37 | — | — |
| Arundo phragmites | 168 | 168 | — | — |
| Phalaris arundinacea | 569 | 415 | 2 | 152 |
| Festuca gigantea | 83 | 60 | 7 | 16 |
| Dactylis glomerata | 20 | 12 | 3 | 5 |

Medens Sklerotierne for de 3 førstnævnte Arter »spirede ud« første Foraar, blev af de 3 sidstnævnte en Del henliggende uspirede, ligesom det er Tilfældet med Frø af mange Planter. Efter i Vinteren 1914—15 igen en Tid at have været udsat for Frost spirede en Del af dem i Foraaret 1915, medens Resten raadnede.

Tabel 2.

| Sklerotier fra | Antal Stromata pr. Sklerotie | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Arundo phragmites | 132 | 34 | 2 | | | | | |
| Molinia coerulea | 10 | 9 | 6 | 7 | 1 | 1 | 1 | 2 |
| Phalaris arundinacea | 230 | 135 | 37 | 11 | 4 | | | |
| Festuca gigantea | 15 | 21 | 22 | 3 | 4 | 1 | 1 | |
| Dactylis glomerata | 4 | 2 | 6 | 1 | 1 | | | 1 |

Tab. 2 viser for de 5 Arters Vedkommende, hvormange Stromata der fremkom af hvert Sklerotium. For den sjette Art, Rugen, var Antallet

Fig. 8.
*Claviceps purpurea.* 7 : 1.
Se Teksten.

langt mere varierende, lige fra 2 til 58, rettende sig efter Sklerotiets Størrelse; i Gennemsnit fandtes her 12.

Fig. 8 viser et forgrenet Stroma, fremkommet af et Sklerotium fra *Dactylis*.

Jeg skal endnu tilføje, at der i flere Tilfælde fandtes betydelige Farvenuancer hos de af de forskellige Meldrøjer fremvoksede Stromata; saaledes svarede Farven hos Stromaet paa *Festuca gigantea*-Sklerotierne for Stokkens Vedkommende til Nr. 588 i Klincksiecks »Code des couleurs« og Hovedet til Nr. 53B, medens de tilsvarende for *Phalaris arundinacea*'s Vedkommende var Nr. 87 og Nr. 62.

## *Laboulbeniaceae.

***Eumonoicomyces papuanus** Thaxt. Paa en lille, sort Rovbille (*Oxyteles rugosus*[1])). København, 29. Juni 1913. (Fig. 9).

Denne Svamp er i Følge Thaxters store Monografi af Laboulbeniaceerne, af hvilke der alene paa Rovbiller er beskrevet 105 Arter i 31 Slægter, hidtil kun kendt fra New Pomerania i Bismarckarkipelet ligeledes paa en *Oxyteles*-Art. Paa min Rovbille fandtes 15—20 Exemplarer af Svampen, fordelt paa Hoved, Thorax, Bagkrop og Ben.

Fig. 9. *Eumonoicomyces papuanus.* 190 : 1.

Opmuntret af dette tilfældige Fund af en Repræsentant for denne i saa mange Henseender mærkelige Svampefamilie, tog jeg d. 25. Maj 1914 ud til Furesøen i Haab om at kunne finde andre Arter paa de under Stenene ved Bredderne saa talrige Løbebiller. Jeg var da ogsaa saa heldig paa denne første Tur at finde Laboulbeniaceer paa hele 5 forskellige Arter Løbebiller, og paa senere Ekskursioner til samme Sted fandt jeg yderligere 2 Arter Løbebiller med Laboulbenier. De af disse, som det er lykkedes mig at bestemme, er følgende 2 Arter:

[1]) Ligesom de fleste af de i det følgende nævnte Billearter bestemt af mag. sc. Kai L. Henriksen, hvorfor jeg ogsaa her bringer ham min bedste Tak.

***Laboulbenia flagellata** Peyr. Paa *Anchomenus albipes* og *A. Krynickii*. S. Furesø, Maj 1914. (Se Tav. I, Fig. 2).

At denne Art i hvert Fald paa dette Sted er meget almindelig, viser en Indsamling fra Sommeren 1915, hvor 17 af 23 indsamlede *Anchomenes albipes* altsaa ca. 75 pCt. var besat med Svampen. Derimod var 25 Individer fra d. 25. September s. A. alle fri for *Laboulbenia*, hvad der tyder paa, at denne kun trives i den varme Sommertid.

***Laboulbenia pterostichi** Thaxt. Paa *Pterostichus nigrita* og *P. strenuus*. S. Furesø, Maj 1914. (Se Tav. I, Fig. 3).

De 3 Løbebillearter, paa hvilke jeg har fundet Laboulbenier, som jeg imidlertid paa Grund af Svampens ufuldstændige Udvikling ikke har været i Stand til at bestemme, er *Anchomenes fuliginosus*, *Pterostichus pygmaeus* og *Elaphrus cupreus*.

## Sphaeriaceae.

**Sordaria curvula** de By. Af denne paa Gødning og henraadnende Plantedele almindelige Svamp fandt jeg i Juli 1913 paa nedfaldne Frugter af *Crataegus monogyna* i Jægersborg Dyrehave en Form med næsten linieformede Perithecier (Tav. I, Fig. 4). Medens Winter angiver Dimensionerne til 750—800 × 350—400 $\mu$ og Schroeter til 600—800 × 300—400 $\mu$ — Perithecierne altsaa dobbelt saa høje som brede — var Gennemsnittet af en Række Maalinger af Perithecier paa *Crataegus*-Frugterne 1060 × 320 $\mu$; disse var altsaa $3^1/_3$ Gange saa høje som tykke. Sporerne var 20—22 × 13—14 $\mu$.

***Sordaria minor** (Ell. et Ev.) Sacc. et Syd. Paa henraadnende Straa af *Calamagrostis sp.* S. Rude Skov, Dec. 1914.

**Sordaria minuta** Fckl. Paa Hundeekskrementer. S. Klosterris Hegn, Marts 1913.

***Sordaria setosa** Wint. Paa døde Frugter af *Platanus orientalis* og *Onobrychis viciifolia* i Spireapparat. København, Febr. 1913. Paa Ekskrementer af *Meles taxus*. S. Gelsskov, Aug. 1915.

Sporesækkene indeholdt 128 Sporer.

**Sordaria pleiospora** Wint. Paa Kogødning. S. Frerslev Hegn, Aug. 1915.

***Pleurage verruculosis** C. N. Jensen. Denne meget ejendommelige Svamp fandt jeg i stor Mængde paa nogle fra Tingskov i Jylland stammende »fodsyge« Havrestraa, der var henlagt paa fugtigt Filtrerpapir i en lukket Glasbeholder (til Undersøgelse for eventuelt forekommende *Fusarium*-Arter), Sept. 1911.

Naar C. N. Jensen, der fandt Svampen i en Jordprøve fra en Havremark[1]), henfører den til Slægten *Pleurage* (= *Sordaria* ex p.), er det for at

[1]) Fungus flora of the soil (Corn. Univ. Agr. Exp. St. o. t. Coll. of Agric. Bull. 315, S. 472 (1912)).

undgaa at opstille en ny Slægt: »It is to be observed that this species is placed in the genus *Pleurage* rather than to form a new genus«, siger han, men jeg tror ikke, han burde være veget tilbage for dette sidste, da Svampen er saa afvigende fra alle andre Arter af Slægten »*Pleurage*«, at der ikke er Tvivl om, at den dog en Gang vil blive opstillet som Typus for en helt ny Slægt.

**Sporormia lageniformis** Fckl. Paa gammel Hestegødning. S. Jægersborg Dyrehave, Gelsskov, Rude Skov.

***Sporormia vexans** Auw. Paa Raadyrekskrementer. S. Tisvilde Hegn, Juni 1915.

***Sporormia corynespora** Niessl. Paa Kogødning. S. Frerslev Hegn, Aug. 1915.

**Trichosphaeria minima** (Fckl.) Wint. Paa Ved af *Fagus silvatica*. S. Gelsskov, Maj 1891.

***Chaetosphaeria fusca** Fckl. Paa nedfaldne Frugter af *Quercus robur*. S. Ermelunden, Marts 1911.

Sporerne 15—21 $\times$ 6—7 $\mu$.

**Melanomma pulvisculum** (Curr.) Sacc. Paa Ved af *Fagus silvatica*. S. Frederiksdal Storskov, Maj 1891.

***Ceratostoma caulincola** Fckl. Paa Frugtskal og Kimblade af spirende Agern (*Quercus robur*). S. Charlottenlund, April 1914. (Tav. I, Fig. 5).

***Ceratosphaeria aeruginosa** Rehm. Paa en død Gren af *Quercus robur*. S. Thureby 1914.

Sporerne 65 $\times$ 5.5 $\mu$.

**Nitschkia cupularis** (Fr.) Krst. Paa dødt Ved. S. Boserup Skov, Okt. 1890.

**Amphisphaeria umbrina** (Fr.) de Not. Paa dødt Ved. S. Jægersborg Dyrehave, April 1891.

**Strickeria obducens** (Fr.) Wint. Paa nedfaldne Askegrene. S. Ermelunden, Okt. 1890.

**Lophiostoma arundinis** (Fr.) Ces. et de Not. Paa døde Straa af *Arundo phragmites*. S. Frederiksdal Storskov, Maj 1891.

***Lophiostoma gramineum** Sacc. Paa døde Straa af *Secale cereale*. J. Nebsager, Juli 1891.

**Stigmatea clymenia** (Sacc.) Schroet. Paa levende Blade af *Lonicera periclymenum*. S. Gelsskov, Sept. 1914.

**Mycosphaerella aquilina** (Fr.) Schroet. Paa *Pteridium aquilinum*. S. Rude Skov, Maj 1914.

**Mycosphaerella Tassiana** (de Not.) Johans. Paa *Juncus effusus*. S. Ravnsholt Hegn, Juli 1914.

**Mycosphaerella maculiformis** (Fr.) Schroet. Paa nedfaldne Frugter af *Fraxinus excelsior*. S. Ermelunden, April 1911.

***Mycosphaerella fraxini** Niessl. Paa nedfaldne Frugter af *Fraxinus excelsior.* S. Ermelunden, Maj 1912.

**Mycosphaerella depazeaeformis** (Auw.) Lind. Paa levende Blade af *Oxalis acetosella.* S. Gelsskov, Juni 1891.

**Mycosphaerella latebrosa** (Cooke) Schroet. Paa Vingerne af nedfaldne Frugter af *Acer pseudoplatanus.* S. Ermelunden, April 1911.

At den af mig fundne Svamp er identisk med, hvad SCHROETER og WINTER forstaar ved *M. latebrosa*, er utvivlsomt, men deres Angivelser af Sporernes Størrelse (WINTER: 18—21 × 3, SCHROETER: meist 20—24 × 2—3 $\mu$), der falder ganske sammen med mine Maalinger, afviger betydeligt fra COOKES, der skriver 0.05 mm lange, en Uoverensstemmelse, som imidlertid ingen af de 2 tyske Forfattere berører.

**Mycosphaerella stemmatea** (Fr.) Rom. Paa levende Blade af *Vaccinium vitis idaea.* S. Ravnsholt Hegn, Juli 1914.

***Metasphaeria rimularum** (Cooke) Sacc. Paa døde Straa af *Arundo phragmites.* J. Nebsager, Juli 1892.

***Didymella hyphenis** (Cooke) Sacc. Paa vissent Løv af *Pteridium aquilinum.* S. St. Hareskov, Juni 1914.

***Didymella aperosa** (Desm.) Sacc. Paa døde Stængler af *Angelica silvestris.* J. Urlev Skov, Juli 1892.

**Leptosphaeria culmifida** Krst. Paa *Festuca arundinacea.* S. Flaskekroen, Juni 1903. Paa *Arundo phragmites.* S. Sjælsø, Juni 1903.

**Leptosphaeria culmifraga** (Fr.) Ces. et de Not. Paa visne Straa af *Calamagrostis arundinacea.* S. Rude Skov, Okt. 1914.

***Leptosphaeria graminis** (Fckl.) Sacc. Paa visne Straa af *Arundo phragmites.* S. Furesø, Maj 1915.

***Leptosphaeria poae** Niessl. Paa visne Topgrene af *Dactylis glomerata.* S. Frederiksdal, Juni 1913.

**Leptosphaeria arundinacea** (Fr.) Sacc. Paa visne Straa af *Arundo phragmites.* S. Kildeskoven v. Gentofte, April 1903, Utterslev Mose, Maj 1903.

**Leptosphaeria Fuckelii** Niessl. Paa visne Straa af *Dactylis glomerata.* S. Frederiksdal Skov, Nov. 1912.

**Leptosphaeria typharum** (Desm.) Krst. Paa visne Blade af *Typha latifolia.* J. Nebsager, Juli 1891.

**Leptosphaeria rubicunda** Rehm. Paa visne Stængler af *Anthriscus silvester.* S. Ordrup Mose, Maj 1903.

**Leptosphaeria doliolum** (Fr.) Ces. et de Not. Paa visne Stængler af *Angelica silvestris.* S. St. Dyrehave, Juli 1903, J. Urlev Skov, Juli 1892. Paa *Urtica dioica.* J. Nebsager, Juli 1891. Paa *Impatiens noli tangere.* J. Sæbygaards Skov, Juli 1893. Paa nedfaldne Frugter af *Fraxinus excelsior.* S. Ermelunden, Febr. 1911.

***Leptosphaeria Niessleana** Rbh. Paa levende Stængler og Blade af *Lathyrus silvester*. S. Gelsskov, Aug. 1915.

***Leptosphaeria galiorum** (Rob.) Niessl. Paa visne Stængler af *Galium aparine*. S. Jægersborg Dyrehave, April 1915.

**Leptosphaeria suffulta** (Fr.) Niessl. Paa visne Stængler af *Melampyrum vulgatum*. J. Sæbygaards Skov, Juli 1893.

**Leptosphaeria dolioloides** (Auw.) Krst. Paa visne Stængler af *Tanacetum vulgare*. J. Kleis, Juli 1891.

**Leptosphaeria derasa** (B. et Br.) Auw. Paa visne Stængler af *Senecio Jacobaea*. J. Nebsager, Juli 1891.

**Leptosphaeria modesta** (Desm.) Auw. Paa visne Stængler af *Daucus carota*. J. Rosenvold, Juli 1891.

**Ophiobolus erythrosporus** (Riess) Wint. Paa visne Stængler af *Urtica dioica*. J. Nebsager, Juli 1891.

**Ophiobolus rubellus** (Fr.) Lind. Paa visne Stængler af *Bunias orientalis*. Kobenhavn, Juli 1903. Paa *Angelica silvestris*. J. Urlev Skov, Juli 1892. Paa Papir. S. Hareskov, April 1914.

**Ophiobolus tenellus** (Auw.) Sacc. Paa visne Stængler af *Medicago sativa*. F. Stige, Maj 1914.

***Pyrenophora trichostoma** (Fr.) Fckl. Paa visne Græsstraa. S. Ravneholmene, Juni 1891.

**Pleospora vagans** Niessl. Paa Skeder af *Calamagrostis arenaria*. S. Hornbæk, Juli 1914.

***Pleospora typhae** Pass. Paa *Typha latifolia*. S. Ørholm, Juni 1891.

**Pleospora salsolae** Fckl. Paa visne Stængler af *Salsola kali*. S. Flaskekroen, Maj 1889.

**Pleospora herbarum** (Fr.) Rbh. Af Planter, som ikke i »Danish fungi etc.« er nævnt som Værter for denne almindelige Art, har jeg noteret følgende: *Koeleria glauca, Typha latifolia, Triglochin maritimum, Iris spuria, Obione pedunculata, Brassica oleracea, Malva alcea, Euonymus europaeus, Pastinaca sativa, Linaria vulgaris*. Endvidere er den tem. alm. paa Papir, der længe har henligget i Skove.

**Pleospora vulgaris** Niessl. Paa *Anthriscus silvester* og *Plantago maritima*. S. Flaskekroen, Maj 1903. Alm. paa Papir, der længe har henligget i Skove.

Tav. I, Fig. 6 viser et Exempel paa Variationen i Antallet af Tværvægge i Sporerne og Antallet af Sporer i Sækkene; de stammer alle 4 fra samme Sporehus paa en *Torilis anthriscus*-Frugt.

**Massaria foedans** (Fr.) Fckl. Paa døde Grene af *Alnus glutinosa*. S. Ermelunden, April 1891.

***Phomatospora ovalis** (Pass.) Sacc. Paa Avner af *Dactylis glomerata*. S. Gelsskov, Marts 1911. Paa Frugter af *Lampsana communis*. S. Lundtofte, April 1912.

Det eneste i Passerinis Beskrivelse af denne Art, som han har fundet paa *Daucus carota*, der ikke helt passer paa mine Exemplarer, er hans Udtryk om Sporesækkene »*aegre conspicuis*«. (Fig. 10).

***Phomatospora Berkeleyi** Sacc. Paa nedfaldne Frugter af *Acer campestre* og *Fraxinus excelsior*. S. Ermelunden, April 1912.

Sporerne 6.5 × 2.5 $\mu$.

**Ceriospora ribis** P. Henn. et Ploettn. Paa døde Grene af *Ribes nigrum*. S. Ermelunden, Sept. 1914.

***Ophiognomonia padi** Jaap. Konidieformen (*Asteroma padi* Grev.) paa levende Blade af *Prunus padus*. S. Ny Holte, Aug. 1891, F. Selleberg, Sept. 1891.

***Gnomonia setacea** (Fr.) Ces. et de Not. Paa visne Blade af *Quercus robur*. S. Gelsskov 1911.

***Gnomonia amoena** (Fr.) Ces. et de Not. Paa visne Blade af *Quercus robur*. S. Gelsskov 1911.

***Gnomonia inclinata** (Desm.) Auw. Paa Bladstilke og Bladenes Underside af *Acer pseudoplatanus*. S. Jægersborg Dyrehave, Febr. 1913.

**Gnomonia erythrostoma** (Fr.) Auw. Tæt bedækkende de fra foregaaende Aar stammende Blade, der endnu — netop paa Grund af Svampens Angreb — i vissen og stærkt sammenkrollet Tilstand i stor Mængde var blevne siddende tilbage paa Grene af *Prunus avium*. S. Dæmpegaard, Maj 1915.

Hvad der hidtil foreligger om Forekomsten i Danmark af denne Svamp, der flere Steder i Tyskland har optraadt epidemisk og meget ødelæggende, er en Notits fra 1902 af E. Rostrup[1]): »Svampen er udbredt over hele Mellemeuropa, og den er naaet til Slesvig og Sydfyn«.

Fig. 10. *Phomatospora ovalis*. En Sporesæk. 560 : 1.

***Rehmiellopsis abietis** (E. Rostr.)!. Under Navnet *Sphaerella abietis* beskrev E. Rostrup i 1902[2]) kortelig en Svamp paa Naale af *Abies alba* (Tav. I, Fig. 7). Efter i nogle Aar at have studeret dens Optræden gav han dernæst en udførligere Beskrivelse af denne i »Tidsskrift for Skovvæsen« 1905 (S. 37); han var nu kommet til den Overbevisning, at det var en ægte Parasit, der gjorde ikke ringe Skade paa forskellige Arter *Abies*, og han var heri enig med en Praktiker som Skovrider E. Moldenhawer, der i Brev af $^{10}/_{10}$ 1908 om denne Sygdom skriver: »Efter mit Skøn skyldes Kalamiteten ikke Frost, men Svampeangreb«, og under $^{12}/_{7}$ 1909: »Angrebet er i Aar endnu mere ondartet end ifjor og har bredt sig over store Arealer. Baade

[1]) Plantepatologi, S. 478.

[2]) l. c. S. 597.

Top- og Sideskud dræbes, mange Graner er halvt afnaalede.... Jeg er alvorlig bange for, at *Sphaerella* skal ødelægge mere, end vi kan taale«.

Ved ifjor at undersøge en fra MOLDENHAWER indsendt Gren af *Abies nobilis*, der aabenbart var angrebet af samme Svamp, saa jeg til min Overraskelse, at Sporesækkene indeholdt et større Antal Sporer end 8 (Fig. 11), og ved at gennemgaa hele det i Botanisk Museum og i Landbohøjskolens plantepatologiske Samling opbevarede Materiale af »*Sphaerella abietis*« (ialt fra 14 forskellige Lokaliteter, og fra flere af disse fra forskellige Tidspunkter) fandt jeg, at samtlige Exemplarer, der havde modne Sporer (fra 7 Lokaliteter, blandt hvilke Typelokaliteten, og saa godt som alle bestemte af E. ROSTRUP), indeholdt flere end 8 Sporer i Sporesækkene, og at alle kunde identificeres med en af BUBÁK og KABÁT i 1910[1]) under Navnet *Rehmiellopsis bohemica* beskrevet Svamp. Der er efter dette ingen Tvivl om, at det beror paa en Fejltagelse, naar E. ROSTRUP beskriver Sporesækkene som 8-sporede, og at Svampen ikke kan henføres til Slægten *Sphaerella*; men dens rette Navn maa da blive *Rehmiellopsis abietis* (E. Rostr.)!.

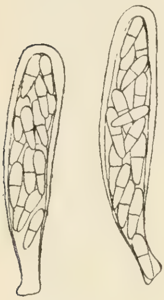

Fig. 11. *Rehmiellopsis abietis.* 2 Sporesække. 400:1.

I ovennævnte Artikel af BUBÁK beskrives paa Ædelgrannaale foruden *Rehmiellopsis* ogsaa en Art *Phoma*, *P. bohemica* Bub. et Kab., og han skriver: »Es ist vollkommen sicher, dass beide Pilze genetisch verbunden sind«. Denne Art findes ogsaa ofte her i Landet paa de syge Ædelgrannaale; E. ROSTRUP omtaler den i den nævnte Artikel i »Tidsskrift for Skovvæsen« og skriver, at »det er rimeligt, men dog ikke tilstrækkelig godtgjort, at det er Formeringsorganer, som tilhører den omhandlede Svamp« (d. e. *Sphaerella abietis*), og at den »udvikles forud for de egentlige Sporehuse«, hvad der ogsaa stemmer med Resulteterne af min Revision af det foreliggende Materiale, idet jeg har fundet denne *Phoma* fra Juli til Oktober, medens det kun er muligt at finde enkelte udviklede Sporer hos *Rehmiellopsis* i Efteraarets og Vinterens Løb. Saaledes skriver Prof. KØLPIN RAVN i Brev af $^{8}/_{12}$ 1908 om den: »Denne sidste er nu ved at danne Sporer; i adskillige Sporesække fandtes flere fuldmodne Sporer, men i Flertallet af Sporesækkene kun halvmodne. Den almindelige Sporemodning og -spredning finder derefter antagelig Sted i Foraarstiden«, hvilket nu ved mine Undersøgelser har fundet fuld Bekræftelse.

De 7 Lokaliteter, hvor *Rehmiellopsis abietis* med Sikkerhed er paavist, er følgende:

[1]) Naturw. Zeitschr. f. Forst- und Landwirtschaft, 1910, S. 313.

Paa *Abies nobilis*: J. Borridsø, Marts 1910.
- *Abies alba*: S. Gelsskov, 31. Okt. 1900, Rude Skov, Maj 1901, St. Hareskov, Okt. 1900, Vedbæk, Marts 1902, J. Tinning Skov, April 1909.
- *Abies cephalonica*: S. Frederiksborg, Juni 1905.

***Anthostomella lonicerae** (Fckl.) Sacc. Paa Grene af *Lonicera periclymenum*. J. Barritskov, Juli 1891.

**Valsa ambiens** Fr. Paa Grene af *Fagus silvatica*. S. Krogenberg Hegn, Okt. 1893, J. Fakkegrav, Aug. 1892. Paa Grene af *Cytisus laburnum*. S. Frederiksdal, Okt. 1891.

**Valsa spinosa** (Fr.) Nke. Paa *Fagus silvatica*. S. Boserup Skov, Okt. 1890.

**Valsa scabrosa** (Fr.) Nke. Paa *Fagus silvatica*. S. Gelsskov, Juni 1891.

***Valsella furva** (Krst.) Sacc. Paa Grene af *Alnus glutinosa*. S. Frederiksdal Storskov, Maj 1891.

***Diaporthe conjuncta** (Fr.) Fckl. Paa Grene af *Corylus avellana*. S. Gelsskov, April 1915, J. Nebsager, Aug. 1891.

**Cryptospora versatilis** (Fr.) Lind. Paa Bark af *Corylus avellana*. S. Boserup Skov, Okt. 1890.

***Cryptospora decorticans** Sacc. Paa *Fagus silvatica*. S. Jægersborg Dyrehave, Nov. 1891.

**Ustulina deusta** (Fr.) Lind. Paa *Daedalea unicolor*. J. Rosenvold, Juli 1891.

**Xylaria carpophila** Fr. Paa nedfaldne Skaale af *Fagus silvatica*. S. Jægersborg Dyrehave, Juli 1915.

## Dothideaceae.

**Rhopographus filicinus** (Fr.) Nke. Om Antallet af Skillevægge i denne Arts Sporer angives almindeligt »3 (sjældnere 5)«. Ved Undersøgelse af et stort Antal Sporer i 2 med et Par Dages Mellemrum samlede Prøver af denne Svamp fandt jeg imidlertid følgende betydelige Uoverensstemmelse:

| | Jægersborg Hegn 19. Juni 1914 | St. Hareskov 23. Juni 1914 |
|---|---|---|
| Sporer med 3 Skillevægge | 97 pCt. | 62 pCt. |
| — - 4 — | 1 — | 7 — |
| — - 5 — | 2 — | 18 — |
| — - 6 — | 0 — | 7 — |
| — - 7 — | 0 — | 6 — |
| | 100 pCt. | 100 pCt. |

Medens altsaa hos forstnævnte Prøve kun 3 pCt. havde mere end 3 Skillevægge, var dette Tilfældet med 38 pCt. hos den anden.

Hvad Størrelsen af Sporerne angaar, skriver WINTER og SCHROETER overensstemmende: 28—30 × 7 $\mu$. En Del Maalinger af Sporerne i de 2 af mig undersøgte Prøver gav imidlertid for den forstnævnte 28—38 × 7—10 $\mu$ og for den anden 37—42 × 8—10 $\mu$.

**Dothidella stellariae** (Lib.) Lind. Paa *Stellaria holostea*. S. Færgelunden, Juli 1910.

**Dothidella thoracella** (Fr.) Sacc. Paa Stængler af *Sedum lividum*. S. Tystofte, Aug. 1888.

## Microthyriaceae.

***Microthyrium microscopicum** Desm. Paa nedfaldne Frugter af *Acer pseudoplatanus*. S. Ermelunden, April 1911.

## Hysteriaceae.

**Lophodermium arundinaceum** (Fr.) Chev. Paa tørre Straa og Blade af *Festuca silvatica*. S. Hæsede, Aug. 1887 (E. Rostrup).

**Lophodermium typhinum** (Fr.) Lamb. Paa Skeder af *Typha latifolia*. S. Rude Skov, Aug. 1914.

**Acrospermum graminum** Lib. Paa Blade af *Bromus Benekeni*. S. Dronninggaard, Juni 1891. Paa Græsstraa, S. Tisvilde, Juli 1894.

## Phacidiaceae.

**Naevia pusilla** (Lib.) Rehm. Paa Stængler af *Juncus effusus*. S. Jægersborg Hegn, Juni 1914, Ravnsholt Hegn, Juli 1914.

**Scleroderris ribis** (Fr.) Lind. Paa *Ribes nigrum*. S. Frederiksdal Storskov, Maj 1891.

***Trochila laurocerasi** (Desm.) Fr. Paa Blade af *Prunus laurocerasus*. S. Fredensborg, Juli 1903.

***Trochila petiolaris** (Fr.) Rehm. Paa Bladstilke og Hovednerver af nedfaldne Blade af *Acer pseudoplatanus*. S. Færgelunden, Juli 1915.

## Cenangiaceae.

***Patellaria corticola** Starb. Paa døde Grene af *Crataegus oxyacantha*. S. Skoven v. Næsseslottet, Maj 1915, Sorø, Juni 1915.

***Tympanis corylina** (Sacc.) Rehm. Paa Grene af *Corylus avellana*. S. Ordrup Mose, April 1905.

**Tympanis conspersa** Fr. Paa *Alnus glutinosa*. S. Frederiksdal Storskov, Maj 1891.

***Tympanis amphiboloides** Nyl. Paa en afbarket Gren af *Quercus robur*. S. Rude Skov, April 1891.

Foruden Sporer med 7 Tværvægge, hvilket er det normale Antal, fandtes ogsaa mange Sporer med 8, 9 og 10 Tværvægge (Fig. 12).

Fig. 12. *Tympanis amphiboloides* Sporer. 560:1.

## Pezizaceae.

**Pseudoplectania nigrella** (Fr.) Fckl. S. Frederiksværk Skov, Marts 1913 (leg. Erik C. Mayland).

**Lachnea gregaria** (Rehm) Phill. I stor Mængde paa sandede Stier i Gelsskov i Aug. 1915.

**Discina ancilis** (Fr.) Rehm. S. Tokkekob Hegn, Maj 1905 (leg. S. Muus).

***Ascophanus lacteus** (Cooke et Phill.) Phill. Paa Kogødning. S. Folehaven, Aug. 1915.

**Ascophanus carneus** (Fr.) Boud. Om denne Svamps Forekomst her i Landet siges der i »Danish Fungi etc.« kun »on dung« (efter E. Chr. Hansen: De danske Gødningssvampe, S. 340). Jeg kan hertil føje, at den er ret alm. i Spireapparater, saavel paa Frø (især af Naaletræer) som paa det Filtrerpapir, Frøene ligger paa.

Naar den i »Danish Fungi etc.« henføres til Slægten *Ascobolus* (skønt den har farveløse Sporer), er det en Fejl, som ogsaa Fries begaar i Syst. myc. II (S. 165), hvor han i Diagnosen af denne Slægt (S. 162) selv skriver »sporidia nigrescentia«.

**Ascophanus Holmskjoldii** Hans. Paa Hjorteekskrementer. S. Jægersborg Dyrehave, Aug. 1914.

**Rhyparobius sexdecimsporus** (Crouan) Sacc. Paa Hestegødning. S. Gelsskov.

***Rhyparobius caninus** (Auw.) Schroet. Paa Ræveekskrementer. S. Rude Skov, April 1915.

***Rhyparobius pachyascus** Zuk. Paa Katteekskrementer, København, April 1915. Paa Hestegødning, S. Gelsskov, April 1915.

**Saccobolus depauperatus** (B. et Br.) Hans. Paa Daadyrekskrementer. S. Jægersborg Dyrehave. Paa Hestegodning. S. Gelsskov.

***Saccobolus obscurus** Cooke. Paa henraadnende Straa af *Avena sativa*. S. Lyngby.

***Saccobolus Beckii** Heimerl. Paa henraadnende Stængler af *Anthyllis vulneraria*. S. Lyngby, Nov. 1914.

***Saccobolus globulifer** Boud. Paa Ræveekskrementer. S. Gelsskov, Aug. 1913.

***Ascobolus brunneus** Cooke. Paa Hestegødning. S. Gelsskov, Juli 1915.

***Ciboria acicola** Kirschst. Paa nedfaldne Naale af *Picea excelsa*. S. Gelsskov 1914.

Asci 85—100 × 7—9 $\mu$, Sporerne 10—12 × 4—4.5 $\mu$.

***Ciboria Sydowiana** Rehm. Paa Bladstilke af *Quercus robur*. S. Gelsskov, Okt. 1914.

**Rutstroemia bolaris** (Fr.) Rehm. Paa henraadnende Grene. S. Gelsskov, Okt. 1914.

**Sclerotinia scirpicola** Rehm. Tav. 2, Fig. 8 viser et Exemplar, hvis Stok har delt sig og bærer 2 Ascomata. S. Furesø, Juni 1915.

**Sclerotinia Curreyana** (Berk.) Krst. Konidieformen (*Sphacelia tenuis* Sacc.) paa *Juncus effusus*. S. Eskemose gaard, Aug. 1913.

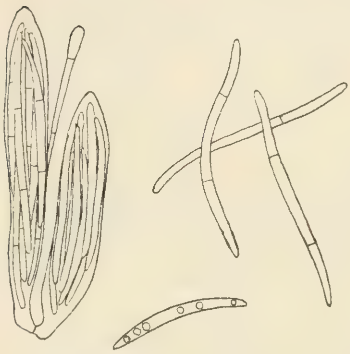

Fig. 13. *Pocillum Boltonii.* Sporesæk og Sporer 400 : 1.

**Dasyscypha pteridis** (Fr.) Rehm. Paa vissent Løv af *Pteridium aquilinum*. S. Jægersborg Hegn, Juni 1914.

**Dasyscypha calycina** (Fr.) Fckl. Paa Stammen af en ung, c. 30 cm høj *Abies grandis*. F. Glorup, Aug. 1907 (leg. F. Lyman).

***Lachnella lonicerae** (A. et S.) Fckl. Paa Grene af *Lonicera periclymenum*. S. Gelsskov.

***Lachnum pallide-roseum** (Saut.) Rehm. Paa Straa af *Dactylis glomerata*. S. Gelsskov, Juli 1912.

**Lachnum virgineum** (Fr.) Krst. Paa Ved af *Fagus silvatica*. S. Frederiksdal Storskov, Maj 1891.

**Lachnum ciliare** (Fr.) Rehm. Paa nedfaldne Blade af *Quercus robur*. S. Gelsskov, Sept. 1914.

**Lachnum fuscescens** (Fr.) Krst. Paa nedfaldne Blade af *Quercus robur*. S. Frederiksværk Skov, Marts 1913.

**Lachnum leucophaeum** (Nyl.) Krst. Paa Stængler af *Anthriscus silvester*. J. Nebsager, Juli 1891.

**Belonioscypha vexata** (de Not.) Rehm. Paa Græsstraa. J. Studsgaard, Maj 1912.

Enkelte Sporer 6-rummede (normalt 4-rummede).

***Pocillum Boltonii** Phill. Paa Stængler af *Equisetum fluviatile*, liggende i Vand. S. Fuglesangsøen, Maj 1915. (Fig. 13).

Skont Phillips' Beskrivelse af Sporerne[1]: »Sporidia 8, elongated, sub-

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[1]) Grevillea 16, S. 94.

cylindrical, obtuse at the ends, 40—50 × 3—4 μ; .... colourless, and furnished with several large vacuoles« i flere Punkter ikke passer paa de af mig fundne, der nemlig er lyst gulbrune, 60—90 × 4 μ og forsynede med 2 Tværvægge, nærer jeg dog ingen Tvivl om, at det er den samme Svamp, vi har haft for os, men at PHILLIPS' ikke har været fuldt modne; thi i umodne Asci har jeg fundet Sporer som af P. beskrevet (den nederste Spore paa Figuren). I Sporesækkene, hvis Størrelse var 72—110 × 14—16 μ, fandtes hyppigt kun 2 eller 4 Sporer.

***Pezizella microspis** (Krst.) Sacc. Paa visne Stængler af *Juncus effusus*. S. Rude Skov, Maj 1915.

***Pezizella inquilina** (Krst.) Rehm. Paa visne Stængler af *Equisetum hiemale*. S. Nørreskov, Aug. 1915.

**Phialea equisetina** (Quel.) Rehm. Paa døde Stængler af *Equisetum fluviatile*. S. Jægersborg Dyrehave, Maj 1915.

***Phialea grisella** Rehm. Paa vissent Løv af *Pteridium aquilinum*. S. Jægersborg Hegn, Juni 1914.

***Phialea acuum** Rehm. Paa nedfaldne Naale af *Picea excelsa*. S. Gelsskov, Dec. 1913.

**Helotium pallescens** Fr. Paa nedfaldne Frugter af *Acer pseudoplatanus*. S. Ermelunden, Marts 1912.

**Trichobelonium Kneiffii** (Wallr.) Schroet. Paa *Arundo phragmites*. S. Furesøen, Maj 1914.

***Mollisia amenticola** (Sacc.) Rehm. Paa nedfaldne Frugter af *Fraxinus excelsior*.

Skønt *Mollisia amenticola* kun er angivet fra Ellekogler, tager jeg ikke i Betænkning at henføre mine Expl. til denne Art, da Beskrivelsen nøje passer.

**Mollisia atrata** (Fr.) Krst. Paa Stængler af *Eupatorium cannabinum*. S. Dronninggaard Skov, Juni 1914.

***Coniocybe furfuracea** Körb. Paa *Polyporus vegetus*. S. Jægersborg Dyrehave, Nov. 1891.

### Helvellaceae.

**Leotia marcida** Fr. Tav. 2, Fig. 9 viser et fra Rude Skov stammende Exemplar med tvedelt Stok.

## Ustilaginales.

### Tilletiaceae.

**Doassansia Martianoffiana** (Thüm.) Schroet. Paa *Potamogeton natans*. S. Lyngby Sø, Sept. 1905. Paa *Potamogeton coloratus*. S. Gurre Sø, Okt. 1893.

**Doassansia alismatis** (Nees) Cornu. Paa *Alisma plantago aquatica*. S. Valby, Aug. 1904.

## Ustilaginaceae.

**Ustilago anomala** Kze. I Frugter af *Polygonum convolvulus*. København, Okt. 1908, J. Sæby, Aug. 1893.

**Ustilago violacea** (Pers.) Gray. I Stovknapper af *Melandryum rubrum*. J. St. Hesteskov v. Horsens, Juni 1904 (K. Wiinstedt). *Melandryum album*. S. Herlufsholm, Juni 1893.

**Ustilago tragopogonis pratensis** (Pers.) Wint. Paa *Tragopogon pratensis*. Bornh. Hammershus, Juli 1885.

**Cintractia subinclusa** (Kke.) Magn. I Frugter af *Carex vesicaria*. S. Gelsskov, Juli 1904. *Carex hirta*. S. Folehaven, Juli 1904.

**Tolyposporium junci** (Schroet.) Wor. Paa *Juncus bufonius*. S. Birkerød, Nov. 1907.

## Uredinales.

### Pucciniaceae.

**Gymnosporangium clavariiforme** DC. Paa *Crataegus Lambertiana*. København 1909.

**Puccinia scirpi** DC. Paa *Scirpus lacustris*. S. Furesø, Nov. 1914, Donse, Okt. 1915.

**Puccinia Pringsheimiana** Kleb. Paa *Ribes nigrum*. S. Sorø, Juni 1915.

**Puccinia sessilis** Schneider. Aecidier paa *Paris quadrifolia*. S. Nørreskov, Juni 1915.

**Puccinia graminis** Pers. Paa *Avena sterilis*. København, Okt. 1886.

**Puccinia polygoni-amphibii** Pers. Uredosporer, der ifølge »Danish Fungi etc.« synes at være sjælden forekommende, fandtes i stor Mængde ved Eskemosegaard 22. Sept. 1914.

**Puccinia libanotidis** Lindroth. Paa Bladstilke af *Libanotis montana*. S. Overby, Aug. 1915.

**Puccinia asperulae-odoratae** Wurth. Paa *Asperula odorata*. S. Gelsskov, Aug. 1914.

**Puccinia tanaceti** DC. Teleutosporehobe paa *Matricaria chamomilla*. S. Nærum, Jan. 1914.

Sporerne 42—51 × 18—19 $\mu$.

**Puccinia millefolii** Fckl. Paa Stængler af *Achillea millefolium*. S. Rude Skov, Sept. 1914.

**Uromyces geranii** (DC.) Otth. Paa *Geranium pyrenaicum*. S. Jægersborg, Lyngby.

**Phragmidium rubi-idaei** (Pers.) Krst. Ved at mikroskopere en d. 26. Sept. 1914 i Rude Skov indsamlet Prøve af Hindbærrust overraskedes jeg ved at finde et betydelig ringere Antal Rum i Teleutosporerne, end der sædvanligt angives i Literaturen (f. Ex. Ed. Fischer: 6—10, hyppigst

7—8, A. B. Frank: 6—10, Paul Hariot: 6—10, Ed. Prillieux: 5—10, J. Schroeter: 7—9, H. et P. Sydow: 5—10, hyppigst 7—8, G. Winter: 6—10), nemlig:

| | | | | | |
|---|---|---|---|---|---|
| 2 pCt. | Sporer | med | 4 | Rum. |
| 33 — | — | — | 5 | — |
| 58 — | — | — | 6 | — |
| 7 — | — | — | 7 | — |

For at se, hvad der var det almindelige Forhold her i Landet, undersøgte jeg dernæst Prøver fra 10 forskellige Steder og optalte Antallet af Rum i 100 Teleutosporer fra hvert Sted; Gennemsnitstallene for disse 1000 Sporer var følgende:

| | | | | |
|---|---|---|---|---|
| c. 5 pCt. | Sporer | med | 5 | Rum. |
| 25 — | — | — | 6 | — |
| c. 40 — | — | — | 7 | — |
| 26 — | — | — | 8 | — |
| 4 — | — | — | 9 | — |

Af 4-rummede fandtes i alt kun 3 og af 10-rummede kun 1.

Tallene fra de forskellige Steder varierede iovrigt overmaade meget, hvad hosstaaende Tabel viser.

Tav. II, Fig. 10 viser en misdannet Spore fra Gelsskov.

Jeg kan endnu tilføje, at jeg har set flere 1-rummede Teleutosporer, men aldrig 2- eller 3-rummede.

| Antal Rum i Teleuto-sporerne | S. Roskilde $^{10}/_{73}$ | S. Farum Lillevang $^{4}/_{10}$ 14 | F. Faaborg $^{5}/_{10}$ 14 | J. Lundby Krat | S. Rude Skov $^{10}/_{10}$ 14 | S. Gelsskov $^{19}/_{10}$ 14 | F. Skaarup $^{5}/_{10}$ 70 | L. Steensgaard $^{27}/_{7}$ 78 | J. Rindsholm $^{27}/_{9}$ 85 | J. Greisdalen $^{20}/_{10}$ 81 | Gennemsnit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | — | 1 | — | 2 | — | — | — | — | — | — | 0,3 |
| 5 | — | 4 | 2 | 9 | — | 8 | 1 | 5 | 3 | 22 | 5,4 |
| 6 | 6 | 20 | 14 | 45 | 12 | 36 | 16 | 27 | 23 | 51 | 25,0 |
| 7 | 36 | 42 | 48 | 36 | 21 | 46 | 41 | 51 | 44 | 27 | 39,2 |
| 8 | 53 | 27 | 35 | 8 | 40 | 10 | 41 | 17 | 29 | — | 26,0 |
| 9 | 4 | 6 | 1 | — | 27 | — | 1 | — | 1 | — | 4,0 |
| 10 | 1 | — | — | — | — | — | — | — | — | — | 0,1 |
| | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100,0 |

# Auriculariales.

## Auriculariaceae.

**Auricularia auriculae Judae** (Fr.) Schroet. Paa *Sambucus nigra.* S. Tisvilde, Juli 1894.

# Dacryomycetales.

## Dacryomycetaceae.

***Dacryomyces fragiformis** (Fr.) Nees. Paa Grene af *Abies alba.* S. Jægersborg Dyrehave, Marts 1903.

# Hymenomycetes.

## Exobasidiaceae.

***Exobasidium mycetophilum** (Peck) Burt. Paa *Collybia dryophila.* S. Frederikslund Skov, Aug. 1908 (leg. S. Muus), Slagelse Skov, Aug. 1912.

**Exobasidium myrtilli** Siegm. Paa *Vaccinium myrtillus.* S. Gribskov, Juni 1903.

## Hypochnaceae.

**Hypochnus coronatus** Schroet. Paa Bark af *Fagus silvatica.* S. Frederikslund Skov, Okt. 1913. Paa Bark af *Picea excelsa.* S. Giesegaard, April 1914.

Basidier med 7 og 8 Sterigmer er ikke helt sjældne.

**Craterellus cornucopioides** Fr. Tav. II, Fig. 11 viser et abnormt Exemplar med 2 Aabninger og noget fascieret Stok. S. Gelsskov.

***Cyphella laeta** Fr. Paa visne Stængler af *Carduus crispus.* København, Aug. 1903.

## Clavariaceae.

**Typhula gyrans** Fr. I April Maaned 1914 samlede jeg i Gelsskov paa et Stykke henraadnende Pap 54 Sklerotier af *Typhula gyrans,* som jeg nogle Dage efter skyllede i Vand, hvorved jeg bemærkede, at de med Hensyn til Vægtfylde kunde deles i 2 Portioner: 24, der gik til Bunds, og 30, der svømmede ovenpaa. Efter at være lagt til Spiring paa fugtigt Filtrerpapir i en Petriskaal (paa hver sin Halvdel af det samme Stykke Papir, saa at alle ydre Forhold nøjagtig var de samme for de 2 Grupper), spirede de i September og Oktober Maaneder s. A., men paa følgende Maade:

| | De Sklerotier, der gik til Bunds | De Sklerotier, der svømmede ovenpaa |
|---|---|---|
| Spiring i September | 17 pCt. | 43 pCt. |
| — 1.—15. Oktober | 8 — | 14 — |
| — 16.—31. — | 58 — | 43 — |
| I alt .... | 83 pCt. | 100 pCt. |
| dode .... | 17 — | 0 — |

Spiringshastigheden stod altsaa i omvendt Forhold til Vægtfylden.

**Pistillaria pusilla** Fr. Paa nedfaldne Frugter af *Crataegus oxyacantha*. S. Ermelunden.

***Hirsutella entomophila** Pat. Paa en *Ptinus rufipes*, fastsiddende paa en Bogestamme. S. Frederikslund Skov, Okt. 1913. (Fig. 14).

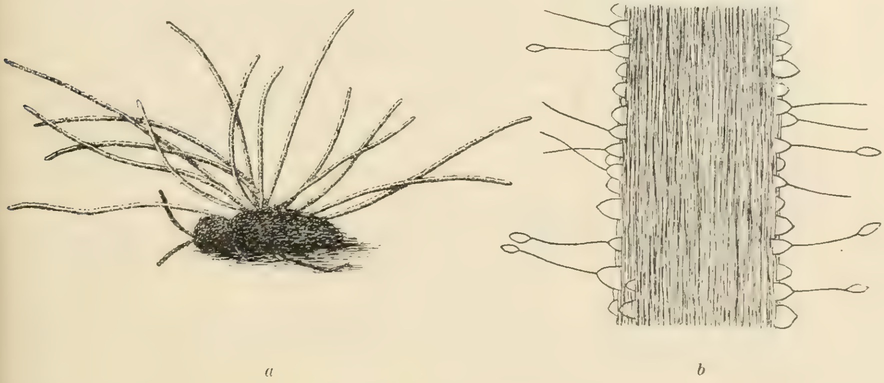


Fig. 14. *Hirsutella entomophila*. *a*. 15 Frugtlegemer paa en *Ptinus rufipes* 7:1, *b*. Et Stykke af et Frugtlegeme 400:1.

Denne Art er tidligere fundet paa en Bille »analogue aux Chrysomèles« i Equador og beskrevet af N. PATOUILLARD[1]). Hans Beskrivelse passer noje paa mit Exemplar, naar undtages Sporernes Storrelse, som han angiver til $8 \times 6\,\mu$, medens mine er $8 \times 4\,\mu$; men af hans Bemærkning om Sporen: »elle est d'abord allongée ovoide, puis se renfle dans sa partie moyenne pour prendre dans l'état adulte un aspect citriforme« slutter jeg, at mit Exemplar ikke har været fuldmodent.

***Clavaria Kunzei** Fr. S. Boserup Skov, Sept. 1905.

**Sparassis crispa** Fr. S. Ravneholmene, Sept. 1910 (leg. Klavs Vedel).

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[1]) Revue mycologique 1892, S. 67.

## Hydnaceae.

**Hydnum pudorinum** Fr. S. Tokkekob Hegn, Maj 1905.

**Odontia fimbriata** (Fr.) Schroet. S. Jægersborg Dyrehave, Juni 1905.

## Polyporaceae.

**Polyporus nummularius** Fr. J. Rugtved Skov, Aug. 1893.

**Polyporus giganteus** Fr. Et Exemplar med fuldstændig midtstillet Stok paa en Bøgestub. S. Jægersborg Dyrehave, Aug. 1914.

**Polyporus alutaceus** Fr. Paa *Picea excelsa*. S. Ravnsholt Hegn, Nov. 1909.

**Polyporus nidulans** Fr. Paa Grene af *Fagus silvatica*. S. Jægersborg Dyrehave, Okt. 1913.

**Polyporus populinus** Fr. Paa *Alnus glutinosa*. S. Ermelunden.

**Polyporus annosus** Fr. Paa *Corylus avellana*. S. Gelsskov, Aug. 1908.

**Polyporus hirsutus** Fr. Paa Grene af *Crataegus monogyna*. S. Ermelunden, Jan. 1915. var. *crassa*. Paa Stammer af *Populus tremula*. S. Frederiksdal Storskov, April 1915.

**Polyporus obliquus** Fr. Paa en dræbt Bogestamme i Jægersborg Dyrehave fandtes i Vinteren 1914—15 et Exemplar med en lodret Udstrækning paa c. 12 m. Mon denne Art ikke skulde sætte Rekorden for Svampefrugtlegemers Størrelse?

I en interessant Meddelelse om denne Svamp[1]) omtaler Franz v. Höhnel nærmere dens plantepatologiske Betydning, som hidtil havde været ganske overset.

**Polyporus sinuosus** Fr. Paa Indersiden af afsprængt Bark af *Acer pseudoplatanus*. S. Ermelunden.

**Polyporus sanguinolentus** Fr. Paa raaddent Ved. S. Folehaven, Aug. 1914.

**Boletus appendiculatus** Fr. I Slutningen af Juli 1908 fandt jeg i Hareskov — tæt ved Hareskovpavillonen — en halv Snes Individer af en mig ubekendt *Boletus*. Jeg sendte nogle Exemplarer til Sev. Petersen, som meddelte mig, at de maatte henfores til *B. appendiculatus*, maaske dog som en Varietet, idet de adskilte sig fra den typiske Form ved »1) at Hattens Farve ikke synes at forandres fra brunt til rodligt, og 2) at Rørene ikke er korte«.

**Boletus pruinatus** Fr. J. Sæbygaard Skov, Juli 1893, Allerup Bakker, Aug. 1893.

**Boletus calopus** Fr. J. Sæbygaard Skov, Juli 1893.

**Boletus castaneus** Fr. S. Jægersborg Hegn, Sept. 1906.

[1]) Oesterr. Bot. Zeits. 1907, S. 177.

# Gasteromycetes.

## Lycoperdaceae.

**Geaster rufescens** Pers. S. Herlufsholm, Dronninggaard Skov.

## Phallaceae.

**Phallus impudicus** Pers. Et Exemplar med en noget fladtrykt og foroven kløftet Stok og Hat med 2 Spidser (Fig. 15). S. Gelsskov, Aug. 1913.

Lignende Abnormiteter omtales af G. Moesz fra Ungarn[1]) og af P. Hennings fra Brandenburg[2]). Noget anderledes — og interessantere — er Forholdet hos en af E. Boudier[3]) beskrevet »développement gémellaire«, hvor Hatten ligeledes har 2 Spidser, men en apikal og en lateral, og hvor der til denne sidste svarer en lille, fri, helt i Hatten skjult Stok.

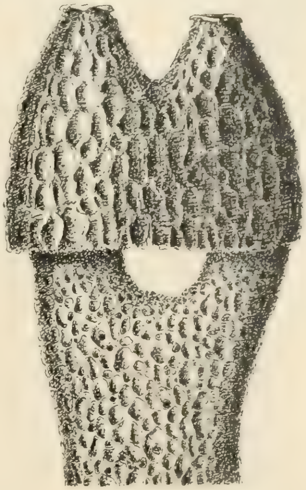

Fig. 15. *Phallus impudicus.* Lidt formindsket.

# Fungi imperfecti.

# Sphaeropsidales.

## Sphaeroidaceae.

***Phyllosticta Ginkgo** Brun. Paa tynde Grene af *Ginkgo biloba.* København, Juni 1888.

Pykniderne 90—170 $\mu$ i Diameter.

***Phyllosticta tiglii** P. Henn. Paa levende Blade af *Codiaeum sp.* S. Gisselfeld (i Væxthus), Nov. 1914 (com. Hother Paludan).

**Phyllosticta mali** Prill. et Delacr. Paa Blade af *Pirus malus.* J. Beder, Juli 1914.

***Phyllosticta cytisorum** Pass. Paa levende Blade af *Cytisus laburnum.* S. Farum Lillevang, Okt. 1914.

***Phyllosticta hederacea** (Arc.) All. Paa levende Blade af *Hedera helix.* København, April 1915.

Denne Svamp, der bl. a. af Saccardo og H. Sydow anses for identisk med eller en Form af *P. hedericola* Dur. et Mont., er af H. Diedicke

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1) Botanikai Közlemények 1911, S. 110.
2) Verh. d. Bot. Ver. d. Prov. Brandenburg 1897, S. 115.
3) Rev. mycol. 1887, S. 3.

gjort til Genstand for en nærmere Undersogelse[1]), i hvilken han paaviser saa mange baade morfologiske og biologiske Forskelligheder fra *P. hedericola*, at han sikkert har Ret i sin Antagelse, at det er 2 »genügend scharf charakterisierte« Arter.

***Phyllosticta plantaginis** Sacc. Paa levende Blade af *Plantago major*. S. Hareskov, Sept. 1915.

***Phyllosticta sambuci** Desm. Paa levende Blade af *Sambucus nigra*. S. Rude Skov, Sept. 1915.

**Phoma strobiligena** Desm. Paa *Thuya occidentalis*. S. Fortunen, April 1903 (leg. S. Muus).

***Phoma arundinacea** (Lév.) Sacc. Paa Straa af *Arundo phragmites*. S. Furesøen, Maj 1914, Sjælsø, Juni 1903.

**Phoma acervalis** Sacc. Paa Grene af *Salix sp.* S. Tokkekob Hegn, Maj 1891.

**Phoma urticae** Schulz. et Sacc. Paa Stængler af *Urtica dioica*. S. Bistruphøj, Okt. 1890.

***Phoma thalictrina** Sacc. et Malbr. Paa torre Stængler af *Thalictrum minus*. S. Overby, Aug. 1915.

**Phoma crataegi** Sacc. Paa nedfaldne Frugter af *Crataegus oxyacantha*. S. Ermelunden.

**Phoma melaena** (Fr.) Dur. et Mont. Paa Stængler af *Medicago sativa*. F. Hemmerslev, Juni 1914.

**Phoma silvatica** Sacc. Paa Stængler af *Melampyrum pratense*. S. Tokkekøb Hegn, Maj 1905.

***Phoma viventis** Cooke. Paa levende Grene af *Lonicera periclymenum*. S. Gelsskov, Sept. 1914, Færgelunden, Aug. 1915.

***Macrophoma coronillae** (Desm.) Neg. I og paa de af *Asphondylia Mayeri* frembragte Galler paa Bælge af *Sarothamnus scoparius*. Kobenhavn.

Af denne »Ambrosiasvamp« findes allerede i Slutningen af Juni inde i Gallen en tæt hvid Belægning af perlesnorformede Hyfer, der fuldstændig omgiver den lille Larve; i sidste Halvdel af Juli fremkommer Pykniderne udenpaa Gallen.

Det er F. Neger, der har paavist denne Svamps interessante biologiske Forhold[2]).

**Phomopsis Durandiana** (Sacc. et Roum.) Lind. Paa Stængler af *Rumex sp.* S. Ermelunden, April 1905 (leg. S. Muus).

***Sphaeronema amenticola** Ces. Paa nedfaldne Frugter af *Quercus robur*. S. Charlottenlund, April 1914.

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[1]) Centralb. f. Bakt. etc., 2. Abt., 19. Bd., S. 168.
[2]) Ber. d. deuts. bot. Ges. 1908, S. 735 og 1910, S. 479.

Pykniderne c. 200 $\mu$ i Diam., Næbet 800—1500 × 22—28 $\mu$, Sporerne ovale, farveløse, 3 × 1.8 $\mu$.

**Vermicularia affinis** Sacc. et Briard. Paa visne Græsstraa. S. Rude Skov, April 1915.

***Dothiorella sorbina** Krst. Paa døde Grene af *Sorbus aucuparia.* S. Frederiksdal Storskov, Okt. 1891.

**Rabenhorstia rudis** Fr. Paa Grene af *Cytisus laburnum.* København, Maj 1913.

***Placosphaeria galii** Sacc. Paa Frugter af *Galium aparine.* S. Jægersborg Dyrehave, April 1915.

***Fusicoccum umbrinum** (Bon.) Berl. et Vogl. Paa Grene af *Corylus avellana.* S. Rude Skov, April 1891.

Sporerne 10 × 1.5 $\mu$ (Fig. 16).

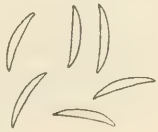

Fig 16. *Fusicoccum umbrinum.* Sporer 800 : 1.

**Cytospora pinastri** Fr. Paa nedfaldne Naale af *Picea excelsa.* S. Gelsskov, Jan. 1914.

***Cytospora decipiens** Sacc. Paa Frugter af *Carpinus betulus.* København, Marts 1912.

**Cytospora ambiens** Sacc. Paa Frugter af *Carpinus betulus.* København, Marts 1912.

**Cytospora personata** Fr. Paa Grene af *Salix cinerea.* S. Gelsskov, Sept. 1891.

**Cytospora microspora** (Cda.) Rbh. Paa Grene af *Crataegus oxyacantha.* J. Sæby, Juli 1893.

***Cytospora capitata** Sacc. et Schulz. Paa Grene af *Pirus malus.* S. Trørød, Juni 1914.

**Cytospora asperulae** Delacr. Paa levende Blade af *Asperula odorata.* S. Basnæs Skov, Sept. 1879 (P. Nielsen).

***Coniothyrium equiseti** Lamb. et Fautr. Paa visne Stængler af *Equisetum fluviatile.* S. Jægersborg Dyrehave, April 1915.

Konidierne 5—8 × 3—4 $\mu$.

**Coniothyrium olivaceum** Bon. Paa visne Blade af *Pinus austriaca* og *P. silvester, Quercus robur* og *Fagus silvatica.* S. Gelsskov 1911. Paa døde Stængler af *Trifolium pratense.* F. Odense, Juli 1914. (Pykniderne 150—250 $\mu$ i Diam., Sporerne 5—6 × 2.5—3.2 $\mu$).

***Coniothyrium arundinaceum** Sacc. Paa døde »Frø« af forskellige Græsser i Spireapparater. København.

***Coniothyrium laburnophilum** Oud. Paa levende Blade af *Cytisus laburnum.* S. Farum Lillevang, Okt. 1914.

***Ascochyta arundinis** Fautr. et Lamb. Paa visne Blade af *Arundo phragmites.* S. Ermelunden, Jan. 1905.

**Ascochyta teretiuscula** Sacc. et Roum. Paa visne Blade af *Luzula pilosa.* S. Gelsskov, Sept. 1914.

***Ascochyta crataegicola** Allesch. Paa Frugter af *Crataegus monogyna*. S. Jægersborg Dyrehave.

Sporerne i mine Exemplarer var lidt større end af ALLESCHER angivet, nemlig 17—20 × 2—4 $\mu$.

**Ascochyta menyanthis** Oud. Paa levende Blade af *Menyanthes trifoliata*. S. Søndersøen, Aug. 1889.

**Diplodina salicis** West. Paa Grene af *Salix sp.* S. Damhussøen, Marts 1903.

***Diplodina acerum** Sacc. et Br. Paa nedfaldne Frugter af *Acer pseudoplatanus*. S. Ermelunden, Nov. 1910.

***Diplodina helianthi** Fautr. Paa døde Stængler af *Helianthus annuus*. København, Okt. 1889.

***Rhyncophoma fulica** n. sp. Peritheciis sparsis, primo innatis, dein subsuperficialibus, subglobosis, 250—350 $\mu$ diam., collo cylindraceo, curvato, radicitus posito, 80—95 $\mu$ crasso, instructis; sporulis cylindraceis, utrinque rotundatis, rectis v. leniter curvatis, uniseptatis (v. interdum continuis), loculis singulis biguttulatis, 11—13.5 × 2—2.8 $\mu$ (Fig. 17).


a b

Fig. 17. *Rhyncophoma fulica*. *a*. En Pyknide 40 : 1, *b*. Konidier 560 : 1.

In pyxidiis et seminibus *Plantaginis lanceolatae*. S. Vedbæk, April 1913.

***Microdiplodia Beckii** (Bäuml.) Allesch. Paa Avner af *Dactylis glomerata*. S. Gelsskov, Marts 1912.

De af mig fundne Pyknider var 130—170 $\mu$ i Diam., medens BÄUMLER angiver 200—250 $\mu$ for sin fra Skeder af *Arundo phragmites* stammende Svamp.

***Microdiplodia pterophila** (Fautr.) Allesch. Paa nedfaldne Frugter af *Fraxinus excelsior*. S. Ermelunden, Nov. 1911.

Sporerne undertiden med 2 og 3 Skillevægge (Tav. II, Fig. 12).

**Microdiplodia microsporella** (Sacc.) Allesch. Paa nedfaldne Frugter af *Fraxinus excelsior*. S. Ermelunden, April 1911. (Tav. II, Fig. 13).

Pykniderne c. 200 $\mu$ i Diam. Sporerne lidt mindre end af SACCARDO angivet, nemlig 6—7 × 2.5—3.5 $\mu$, og for en Del enrummede.

**Diplodia subtecta** Fr. Paa en død Stamme af *Acer pseudoplatanus*. S. Jægersborg Dyrehave, Nov. 1913.

***Botryodiplodia crataegi** Vestergr. Paa Grene af *Fagus silvatica*. S. Eskemosegaard Skov, Juni 1903.

Skønt *B. c.* kun er angivet fra *Crataegus*, tager jeg ikke i Betænkning at henføre den af mig fundne Svamp til denne Art, da Beskrivelsen nøje passer.

***Stagonospora megistospora** n. sp. Peritheciis sparsis, immersis, globoso-papillatis, nigris, 350—430 $\mu$ diam., pariete 25 $\mu$ crasso. Sporulis oblongo-fusoideis, apice rotundatis, basi truncatis, 6—10-septatis, multiguttulatis, 118—137 × 14—17 $\mu$; basidiis dispersis, cylindraceis, uniseptatis, 16 × 3 $\mu$. (Fig. 18).

In culmis languidis *Scirpi lacustris*. S. Ved Furesøen, April 1912.

***Stagonospora vexatula** Sacc. Paa døde Straa af *Arundo phragmites*. S. Sjælsø, Juni 1903. Bornh. Aarsdale, Juni 1889.

**Stagonospora subseriata** (Desm.) Sacc. Paa visne Straa af *Calamagrostis arenaria*. S. Hornbæk, Juli 1914.

***Hendersonia equisetina** n. sp. Peritheciis gregariis, in maculis pallescentibus innatis, pariete tenui sed obscure fusco, 145—175 $\mu$ diam. Sporulis cylindricis, utrinque rotundatis, rectis v. curvatis, 4—7-septatis, suffusco-cinereis, 44—58 × 4—4.5 $\mu$, in massa nigricanti exhaustis. (Tav. II, Fig. 14).

In caulibus putrescentibus *Equiseti fluviatilis*. S. Jægersborg Dyrehave, Maj 1915.

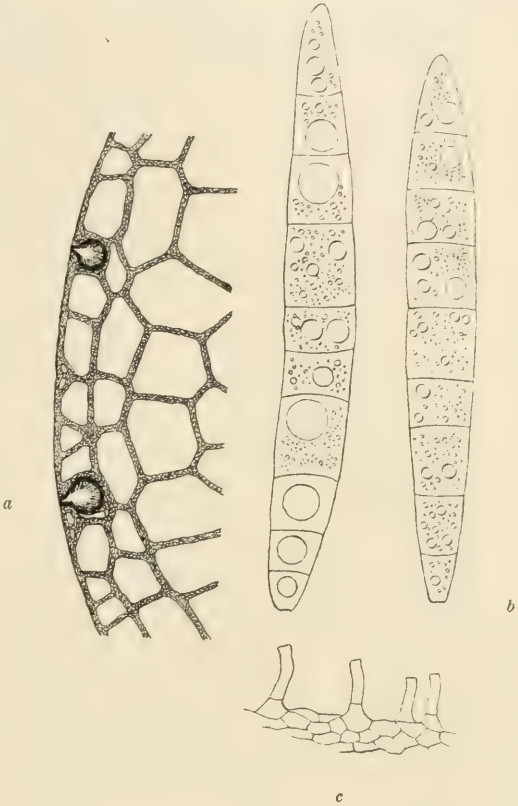


Fig. 18. *Stagonospora megistospora*. *a*. 2 gennemskaarne Pyknider 11 : 1, *b*. 2 Konidier 560 : 1, *c*. Konidiestilke 560 : 1.

**Hendersonia crastophila** Sacc. Paa døde Straa af *Arundo phragmites*. S. Frederiksdal Skov, Maj 1905.

**Hendersonia phragmitis** Desm. Paa visne Skeder af *Arundo phragmites*. S. Farum Sø, Juni 1914, Færgelunden, Juni 1914.

***Hendersonia arundinacea** (Desm.) Sacc. Paa visne Straa af *Calamagrostis lanceolata*. S. Kirkelte Hegn, Maj 1915.

***Hendersonia punctoidea** Krst. Paa Frugter af *Betula verrucosa*. S. Charlottenlund, April 1910.

***Camarosporium phragmitis** Brun. Paa visne Skeder af *Arundo phragmites*. S. Furesø, Juli 1914.

***Camarosporium propinquum** Sacc. Paa døde Grene af *Salix purpurea*. S. Ved Vintappersøen, Maj 1905.

**Rhabdospora arundinis** (Mont.) Allesch. Paa visne Straa af *Bromus inermis*. København, Juni 1889.

***Rhabdospora narvisiana** (Sacc.) Allesch. Paa visne Stængler af *Scirpus lacuster*. S. Stenholt Vang, Juli 1903.

**Rhabdospora junci** (Desm.) Allesch. Paa døde Stængler af *Juncus effusus*. S. Gelsskov, Marts 1915.

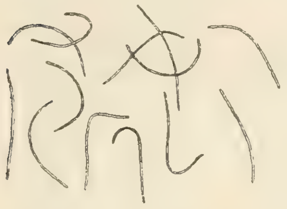

Fig. 19. *Rhabdospora pastinacina*. Konidier 560 : 1.

***Rhabdospora pastinacina** (Sacc.) Allesch. Paa Frugter af *Heracleum sphondylium*. København, Sept. 1911. F. Bolteskov, Aug. 1912.

Sporerne 20—30 × 1 $\mu$. (Fig. 19).

***Rhabdospora campanulae** Fautr. Paa døde Stængler af *Matricaria chamomilla*. S. Nærum, Jan. 1914.

Da FAUTREYS Beskrivelse (»Périthèces épars, sousépidermiques, érumpents par l'ostiole; spores filiformes 40—60 × 2 à gouttes«) ganske passer paa den af mig fundne Svamp, henfører jeg den til denne Art, skont det jo p. G. a. Beskrivelsens Kortfattethed er umuligt med Sikkerhed at sige, om vore Svampe er identiske. De af mig fundne Pyknider var 180—240 $\mu$ i Diam., og jævnlig var de noget langstrakte i Stængelens Længderetning, og Sporerne var 47—62 × 1.7—2 $\mu$.

***Septoria brachypodina** n. sp. Maculis valde effusis, laete ferrugineis, immarginatis; peritheciis amphigenis, gregariis, lenticularibus, 100—125 $\mu$ diam., saepe 2—3 confluentibus. Sporulis cylindricis, rectis, continuis, hyalinis, 4—5 × ½ $\mu$. (Fig. 20, Tav. III, Fig. 17).

Ad folia adhuc viva *Brachypodii silvatici*. S. Gelsskov, Okt. 1913.

Fig. 20. *Septoria brachypodina*. Konidier 800 : 1.

***Septoria polygonicola** (Lasch) Sacc. Paa levende Blade af *Polygonum persicaria*. S. Folehaven, Rude Skov, Aug. 1915.

**Septoria posoniensis** Bäuml. Paa levende Blade af *Chrysosplenium alternifolium*. S. Endrup Hegn, Juni 1904.

**Septoria oxalidis** Rostr. Paa levende Blade af *Oxalis acetosella*. S. Folehaven, Aug. 1915.

**Septoria stachydis** Rob. et Desm. Paa levende Blade af *Stachys silvatica*. S. Bøndernes Hegn, Sept. 1915.

**Phleospora pseudoplatani** (Rob. et Desm.) Lind. Paa Frugter af *Acer pseudoplatanus*. S. Tisvilde, Juli 1894.

***Eriospora achaenioides** n. sp. Stromatibus sparsis, immersis, globoso-depressis, intus in 5—8 loculamenta divisis. Sporulis filiformibus, 43—75 × 0.8 μ, 7—11 in eodem basidio insidentibus et cohaerentibus; basidiis cylindraceis, 7—12 × 1 μ. (Fig. 21).

In samaris dejectis *Fraxini excelsioris*. S. Ermelunden, Marts 1911.

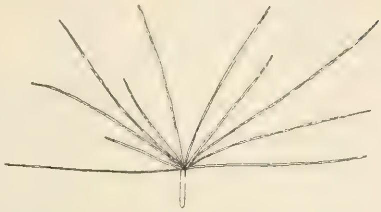

Fig. 21. *Eriospora achaenioides.* Konidier 400 : 1.

## Nectrioidaceae.

***Xythia pinastri** Krst. Paa nedfaldne Naale af *Pinus montana*. J. Klosterheden, Marts 1915.

***Sphaeronaemella fimicola** March. Paa Hestegodning. S. Hareskov, Juli 1913.

De af mig fundne Pyknider var noget mindre end MARCHALS, nemlig kun 70—100 μ i Diam. med et 190—300 μ langt Næb, og Sporerne var i mine Exemplarer forsynede med en Oliedraabe i hver Ende. (Fig. 22).


Fig. 22. *Sphaeronaemella fimicola.* *a.* Pyknide 95 : 1. *b.* Konidier 560 : 1.

## Leptostromataceae.

**Leptothyrium periclymeni** (Desm.) Sacc. Paa levende Blade af *Lonicera periclymenum*. S. Ermelunden, Aug. 1915.

**Leptostroma filicinum** Fr. Paa Bladstilke af *Osmunda regalis*. L. Stokkemarke Mose, Juli 1884.

**Leptostroma juncacearum** Sacc. Paa visne Stængler af *Juncus effusus*. S. Gelsskov, Nov. 1914.

***Leptostroma spiraeae** Fr. Paa visne Stængler af *Spiraea ulmaria*. S. Lyngby Mose, April 1889.

Adskiller sig fra den i »Danish Fungi etc.« som alm. angivne *L. spiraeinum* (Sacc. et Briand) Vgr., hvis Sporer er 7—8 × 3.5—4 μ, ved at have Sporer, der kun er 6 × ¾ μ.

**Leptostroma lineare** Lév. Paa døde Stængler af *Tanacetum vulgare*. J. Kleis, Juli 1891.

***Leptothyrella Mougeotiana** Sacc. et Roum. Paa levende Naale af *Pinus pinaster*. S. Charlottenlund, Juni 1891.

## Excipulaceae.

**Discula microsperma** (B. et Br.) Sacc. Paa Grene af *Salix sp.* S. Tokkekøb Hegn, Maj 1891.

**Dinemasporium graminum** Lév. Paa visne Blade af *Luzula pilosa*. S. Gelsskov, Aug. 1914.

## Melanconiales.

***Gloeosporium gallarum** Ch. Rich. Paa Galler, frembragt af *Dryophanta sp.*, paa Blade af *Quercus robur*. S. Hareskov, Aug. 1915.

**Gloeosporium equiseti** Ell. et Ev. Paa *Equisetum fluviatile*. S. Eskemosegaard, Aug. 1913.

***Gloeosporium musarum** Cooke et Mass. var. *importatum* Laubert. Paa importerede Frugter af *Musa*. København, Aug. 1912.

Konidierne 15—20 × 7—8 μ; COOKE et MASSEE angiver for Hovedarten 10—12 × 4 μ, og R. LAUBERT[1]) har for Varieteten: 9—24 × 5—7 μ.

Fig. 23. *Marssonina potentillae*. 800 : 1. Se Teksten.

**Gloeosporium samararum** All. Paa nedfaldne Frugter af *Fraxinus excelsior*. S. Lave Skov, Aug. 1910.

**Gloeosporium acerinum** West. Paa Blade af *Acer platanoides*. København, Okt. 1893.

***Myxosporium cytisi** P. Henn. Paa Grene af *Cytisus laburnum*. S. Trørød, Juni 1915.

**Melanconium typhae** Peck. Paa visne Blade af *Typha latifolia*. S. Folehaven, Juni 1914.

***Marssonina necans** (Ell. et Ev.) Sacc. Paa levende Blade af *Pteridium aquilinum*. S. Hareskov, Aug. 1915.

**Marssonina potentillae** (Desm.) Magn. I Aug. 1914 saa jeg i en Gartnerhave i København et større Stykke Jordbær, der var meget stærkt angrebet af nævnte Svamp. Det var mig strax ved den mikroskopiske Undersøgelse paafaldende, at Sporerne baade med Hensyn til Form og Størrelse afveg noget fra det normale. I hosstaaende Fig. 23 ses til venstre Sporer

[1]) Gartenflora 59, S. 412.

af denne noget afvigende Form, medens der til højre til Sammenligning er anbragt nogle normale Sporer fra en Prøve — ligeledes paa Jordbær — fra Tranekær (Aug. 1913), begge tegnede i frisk Tilstand; Længden af Sporerne var 25—28 $\mu$ for den københavnske og 17—20 $\mu$ for den langelandske Prøve (ALLESCHER har 20—25 $\mu$); en Prøve, stammende fra *Potentilla reptans*, stemte ganske overens med den sidstnævnte, hvorimod Exemplarer fra *Potentilla tormentilla* og *Comarum palustre* havde noget smallere Sporer, især for den nederste Celles Vedkommende (Fig. 24).

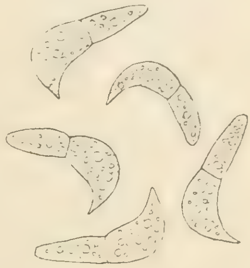

Fig. 24. *Marssonina potentillae.* 800 : 1. Se Teksten.

***Stilbospora angustata** Fr. Paa døde Grene af *Ulmus montana.* F. Juelsberg, Sept. 1891.

**Coryneum pulvinatum** Fr. Paa Stammen af *Tilia europaea.* S. Benzonsdal, Okt. 1889 (E. Rostrup).

***Coryneum ruborum** Oud. Paa døde Stængler af *Rubus idaeus.* J. Beder, Juli 1914.

**Asterosporium Hoffmanni** Fr. Denne paa Bøgekviste saa almindelige Svamp har jeg fundet paa nedfaldne Frugter af *Fagus silvatica* og *Carpinus betulus*, henholdsvis i Jægersborg Dyrehave og Frederiksberg Have.

***Monochaetia compta** Sacc. *var. ramicola* Berl. et Bres. Paa døde Grene af *Rosa canina.* S. Dronninggaard, Juni 1891.

***Pestalozzia conigena** Lév. Paa Kogler af *Thuya occidentalis.* København, April 1915.

***Pestalozzia montellica** Sacc. et Vogl. Paa visne Blade af *Quercus robur.* S. Gelsskov 1911.

**Steganosporium piriforme** (Fr.) Cda. Paa Grene af *Acer pseudoplatanus.* F. Selleberg, Sept. 1891.

# Hyphomycetes.

## Mucedinaceae.

***Oospora candidula** Sacc. Paa døde Naale af *Pinus silvestris* og *P. nigra.* S. Gelsskov 1911.

***Monilia aurea** (Cda.) Sacc. Paa raaddent Ved af *Fagus silvatica.* S. Jægersborg Dyrehave, Juli 1915.

**Cylindrium griseum** Bon. Paa nedfaldne Blade af *Quercus sp.* København, Sept. 1903.

***Cylindrium elongatum** Bon. Paa nedfaldne Blade af *Quercus robur.* S. Gelsskov 1911.

***Cylindrium clandestinum** (Cda.) Sacc. Paa nedfaldne Frugter af *Acer pseudoplatanus*. S. Ermelunden, Nov. 1912.

Konidierne 12—15.5 × 2 $\mu$.

***Oedocephalum fimetarium** (Riess) Sacc. Paa Hestegødning. S. Gelsskov, Juli 1915.

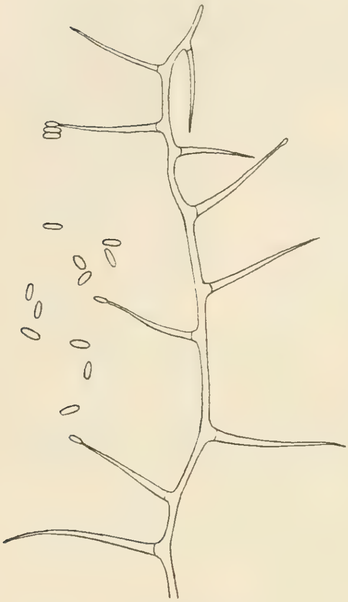

Fig. 25. *Cephalosporium roseum.* 400 : 1.

***Rhopalomyces elegans** Cda. Paa henraadnende Plantedele (*Brassica oleracea, Lolium italicum*). Amager, Dec. 1913, S. Tystofte, Juni 1915.

***Coronella nivea** Crouan. Paa Ræveekskrementer. S. Gelsskov, Dec. 1914.

Et Forsøg paa at rendyrke denne meget ejendommelige Svamp, der ikke synes at være genfunden, siden CROUAN fandt den i Dep. Finistère i Frankrig, mislykkedes desværre, idet mine Kulturer blev forurenede af en *Mucor*-Art, som den voksede imellem (eller paa ?).

Da CROUAN ikke anfører Maal, skal jeg tilføje, at de radiært udstraalende sporebærende Grene, af hvilke der fandtes 9—18, var 40—50 $\mu$ lange og de tenformede Sporer 11—12 × 3—3.5 $\mu$.

***Cephalosporium roseum** Oud. Paa visne Stængler af *Equisetum fluviatile*. S. Fuglesangsøen, Maj 1915.

I sin Originalbeskrivelse[1]) skriver OUDEMANS om Hyferne »continuis«; herved sætter LINDAU i RABENHORST's Kryptogamenflora et »?«. Som Fig. 25 viser, fandt jeg ingen Skillevægge i de meget tynde, krybende Hyfer, medens der fandtes saadanne over Basis i de oprette, konidiebærende Grene.

***Cephalosporium acremonium** Cda. Paa henraadnende Plantedele. S. Jægersborg Dyrehave, April 1914, Ruderhegn, Juli 1914. Tem. alm. paa døde Frø i Spireapparater.

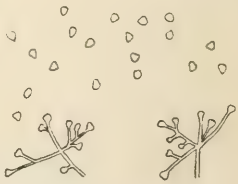

Fig. 26. *Trichoderma album.* 800 : 1.

***Trichoderma album** Preuss. Paa Mykorrhizer paa Rødder af *Pinus montana*. J. Hjortsballehøje. (Fig. 26).

Om det er PREUSS' Art, der foreligger, er ikke helt sikkert, men det er i hvert Tilfælde den Art, som ELISABETH DALE i sin Artikel »On the

[1]) Ned. Kruidk. Arch., 2. Sér., 4. Bd., S. 249.

fungi of the Soil«[1]) nærmere beskriver under ovennævnte Navn. Hun ender ogsaa med at skrive: »The description of *T. album* (Rabenhorst I, 8) agrees in many respects with my culture, but I did not find any covering of hairs on the colonies, and the spores are not round. The species is however incertain according to LINDAU«.

***Cylindrocephalum lycotropum** (Preuss)!. Under Navnet »Hufeisenförmiger Spindelstaub, *Fusidium lycotropum*« beskrev og afbildede PREUSS[2]) i 1851 en Svamp, der utvivlsomt er identisk med en af mig paa Askefrugter fundet Art. Medens PREUSS meget korrekt afbilder Konidierne, har han aabenbart ikke set Konidiebærerne, der ogsaa er meget smaa og uanselige, nemlig kun 14 $\mu$ høje og 4 $\mu$ tykke. Paa korte Stilke bærer de i Spidsen 2—3 Konidier. SACCARDO[3]) og LINDAU[4]) er enige om, at denne Art næppe kan henføres til Slægten *Fusidium*; hvis man ikke vil basere en ny Slægt paa den, forekommer det mig, at den maa henføres til Slægten *Cylindrocephalum*. (Fig. 27).

Fig. 27. *Cylindrocephalum lycotropum*. 560 : 1.

Paa nedfaldne Frugter af *Fraxinus excelsior*. S. Ermelunden, Marts 1911.

***Harzia acremonioides** (Harz) Cost. Paa henraadnende Plantedele, vistnok alm. (f. Ex. meget hyppig paa døde Frø i Spireapparater).

***Aspergillus minimus** Wehm. Paa døde Naale af *Pinus silvestris*. S. Gelsskov 1911.

***Aspergillus sulphureus** (Fres.) Wehm. Paa døde Frø i Spireapparater. København.

***Aspergillus varians** Wehm. Isoleret fra en Jordprøve. J. Vrou Hede.

Konidiebærerne 330—500 $\times$ 5 $\mu$, med eller uden Skillevægge, hyppigst uden, farveløse — ganske svagt brunfarvede, tykvæggede. Sterigmerne ugrenede eller grenede. Konidierne olivengrønne, 3 $\mu$ i Diameter.

I gamle Kulturer paa Ølurtgelatine fandtes der hist og her i det tykke Myceltæppe Grupper af runde Celler (Tav. II, Fig. 16), der ganske mindede om f. Ex. *Aspergillus nidulans*'s saakaldte »Blasenhülle«.

**Penicillium candidum** Fr. Paa henraadnende Frø af *Pisum sativum*. København.

***Penicillium roseum** Fr. Paa henraadnende Plantedele (*Pinus*, *Pisum*). København, Gelsskov 1911.

***Penicillium brevicaule** Sacc. Paa døde Frø i Spireapparater. København.

[1]) Ann. myc. 1912, S. 461.
[2]) Sturm: Deutschlands Flora, 3. Abt. VI., S. 57.
[3]) Syll. IV, S. 28.
[4]) Rbh. Krypt-Fl., 2. Auf. 1. Bd. 8. Abt. S. 63.

*__Penicillium fulvum__ Rbh. Paa døde Frø i Spireapparater. København.

Af de talrige Former af den gamle »*Penicillium glaucum*«, som jeg nærmere har undersøgt ved Dyrkning paa forskellige Substrater, er det lykkedes mig at identificere følgende:

Fig. 28. *Briarea aurosa.* 260:1.

*__Penicillium expansum__ (Lk.) Thom. Paa Blade af *Quercus robur.* S. Gelsskov 1911.

*__Penicillium tabescens__ Westl. Fra Jordprøve. J. Vrou Hede.

*__Penicillium claviforme__ Bain. Paa Blade af *Quercus robur.* S. Gelsskov 1911.

*__Penicillium pinophilum__ (Hedgcock) Thom. Paa Blade af *Quercus robur.* S. Gelsskov 1911.

*__Penicillium spinulosum__ Thom. Paa henraadnende Plantedele (*Pinus, Fagus, Quercus*), i Jordprøver. S. København, Gelsskov, J. Holt Hede.

*__Penicillium viridicatum__ Westl. Paa henraadnende Plantedele (*Pinus, Secale, Quercus*). S. København, Gelsskov.

*__Penicillium lividum__ Westl. Paa raadne Blade af *Fagus silvatica.* S. Gelsskov 1911.

*__Penicillium corymbiferum__ Westl. I en »Luftanalyse«. København 1915.

*__Penicillium notatum__ Westl. Paa *Ulocolla foliacea.* S. Gelsskov. I Jordprøver. J. Gludsted Plantage, Sdr. Feldborg Plantage.

*__Penicillium solitum__ Westl. Paa hollandsk Ost. København.

*__Penicillium rubrum__ O. Stoll. Paa raadne Blade af *Quercus robur.* S. Gelsskov. I en Jordprøve. J. Rind Krat.

*__Penicillium italicum__ Wehm. Paa Abildsiner. København.

Ved Dyrkning paa Ølurtgelatine frembragtes de for denne Art karakteristiske Sklerotier.

*__Penicillium glabrum__ (Wehm.) Westl. I Jordprøve. J. Holt Plantage.

*__Penicillium Pfefferianum__ (Wehm.) Westl. Paa raadne Naale af *Pinus nigra.* S. Gelsskov 1911.

*__Briarea aurosa__ n. sp. Caespitulis minutis, aureis. Hyphis fertilibus erectis, robustis, triseptatis, pallide fulvis, 340—375 × 15—21 $\mu$, apice in denticulis minutissimis catenas conidiorum gerentibus; conidiis globosis, intus granulosis, aureis, 7 $\mu$ diam. (Fig. 28).

In charta bibula humida. København (leg. K. Dorph-Petersen).

*__Sporotrichum Kirchneri__ n. sp. I en Artikel »Eine Milbenkrankheit des Hafers«[1]), foraarsaget af *Tarsonemus spirifex*, skriver O. Kirchner: »Zum Schluss mag erwähnt sein, dass die in den Blattscheiden des Hafers dicht gedrängt beisammen lebenden Milben häufig von einem Pilz bewohnt waren, welcher ihren ganzen Körper durchwucherte, aus den Extremitäten herauswuchs und in der Nachbarschaft sich ausbreitend andere Individuen, meistens zuerst an den Extremitäten, ergriff. Der Pilz gehört als eine anscheinend noch nicht beschriebene Art zu der Gattung *Sporotrichum* Link . . ., und machte ganz den Eindruck eines Parasiten, der die Milben tötet, indessen liess sich diess nicht mit Sicherheit feststellen, da das Material zu Infektionsversuchen nicht geeignet war«.

Jeg formoder, at det er den samme Art, som jeg har fundet i Mængde ligeledes paa *Tarsonemus spirifex* paa Havre fra Lundby i Sydsjælland i Juni 1913, og som jeg vil tillade mig at opkalde efter Prof. O. Kirchner:

**Sporotrichum Kirchneri** n. sp. Specie oculo nudo non conspicuo. Hyphis ex extremitatibus *Tarsonemi* oriundis, repentibus, septatis, 2 $\mu$ cr., ramis conidiophoris sparsis v. oppositis, ad septa oriundis, extense lageniformibus; conidiis ovoideis, 3.7—4.4 $\times$ 2.5 $\mu$. (Fig. 29)[2]).

Fig. 29. *Sporotrichum Kirchneri.* Mide med Svampen 160 : 1, Fig. t. v. 550 : 1.

In *Tarsonemo spirifici* in *Avena sativa* parasitanti.

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[1]) Zeits. f. Pflanzenkrankheiten 14. Bd. S. 1 (1904).

[2]) I »Tijdschrift over Plantenziekten« 1915 (S. 121) omtaler og afbilder T. A. C. Schoevers i en Artikel »Een nieuwe havervijand (*Tarsonemus spirifex*)« en Svamp, der sandsynligvis er den samme som foreliggende, om end Ordene »soms drie of vier« i hans Beskrivelse »Op de plaats van den steel van de peer zaten soms een, soms drie of vier zeer dunne korte draden, die aan hun top elk een kleine, ronde conidië droegen« ikke passer paa mine Exemplarer.

***Sporotrichum fimicola** n. sp. Caespitulis exiguis, laxe contextis, albis. Hyphis ramosissimis, septatis, 4 μ cr.; conidiis late obovoideis, basi truncatis, intus granulosis, 10—14 × 5—10 μ. (Fig. 30).

Fig. 30. *Sporotrichum fimicola.* 600 : 1.

Ad excrementa *Canis familiaris.* S. Klosterris Hegn, Marts 1913.

***Monosporium acuminatum** Bon. *var. terrestre* Sacc. Paa henraadnende *Xylaria polymorpha.* S. Ermelunden, Okt. 1914.

**Botrytis Bassiana** Bals. Paa en *Sitona lineata.* S. Lyngby, Sept. 1914.

Paa Ølurtgelatine trivedes Svampen overmaade frodigt; af forskellige Insekter, som blev overdrysset med Konidier fra en saadan kunstig Kultur, inficeredes og dræbtes den alm. Mariehøne (*Coccinella 7-punctata*) (2 af 4 Individer), en *Elaphrus cupreus,* en Spyflue (*Calliphora erythrocephala*) samt en Larve af Natsværmeren *Lachnocampa rubi,* medens en Ørentvist og et Tusindben ikke angrebes.

***Botrytis isabellina** Preuss. I Mængde paa *Claviceps purpurea*-Sklerotier fra *Phalaris arundinacea.* København, Juni 1914. Paa nedfaldne Naale af *Picea excelsa.* S. Boserup Skov, Juli 1914.

Konidiebærerne 2—3 Gange dikotomt forgrenede, 400—600 μ høje, 7—14 μ tykke. Konidierne 7—10 (—14) μ i Diameter.

***Botrytis lutescens** Sacc. et Roum. Paa henraadnende Blade af *Pinus, Picea* og *Fagus.* S. Gelsskov 1911.

***Botrytis pilulifera** Sacc. Paa Ekskrementer og henraadnende Plantedele. S. København, Gelsskov, F. Middelfart.

***Cylindrodendrum album** Bon. Paa nedfaldne Frugter af *Quercus robur, Fraxinus excelsior* og *Acer pseudoplatanus.* S. Charlottenlund, Ermelunden. Paa Stængler af *Medicago sativa.* S. Vemmetofte. (Fig. 31).

**Ovularia cynoglossi** (Liro) Lind. Paa levende Blade af *Cynoglossum officinale.* S. Jægersborg Dyrehave, Aug. 1914.

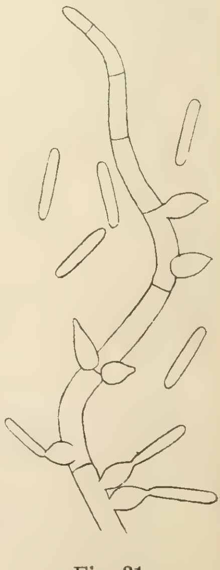

Fig. 31. *Cylindrodendrum album.* 560 : 1.

***Pachybasium hamatum** (Bon.) Sacc. Paa raaddent Ved af *Picea excelsa*. S. Giesegaard, April 1914. *var. candidum* Sacc. Paa Undersiden af nedfaldne Blade af *Quercus robur*. S. Gelsskov, Aug. 1914.

***Pachybasium niveum** n. sp. Caespitulis velutinis, niveis. Conidiophoris adscendentibus, septatis, ramis mediis sterilibus, lateralibus sparsis, ramosis, ramulis ultimis medio globoso inflatis, $18 \times 3\,\mu$, conidia singularia gerentibus; conidiis globosis, $2\,\mu$ diam. (Fig. 32).

In terra arenosa.

Isoleret fra Jordprøver fra Vrou Hede og Holt Hede i Jylland (baade fra 10, 30 og 60 Cm.s Dybde).

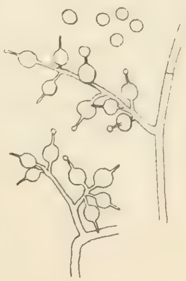

Fig. 32. *Pachybasium niveum.* 800:1.

***Verticillium paniculatum** n. sp. Caespitulis effusis, raris, albis. Hyphis sterilibus repentibus dense septatis, parum ramosis; fertilibus erectis, 250—450 $\mu$ altis, septatis, apicem versus pauculos verticillos, e 3—4 ramis in totidem ramulis conidiophoris exientibus constantes, gerentibus. Conidiis obovoideis, basi acutis, $5—6 \times 2.5—3\,\mu$. (Fig. 33).

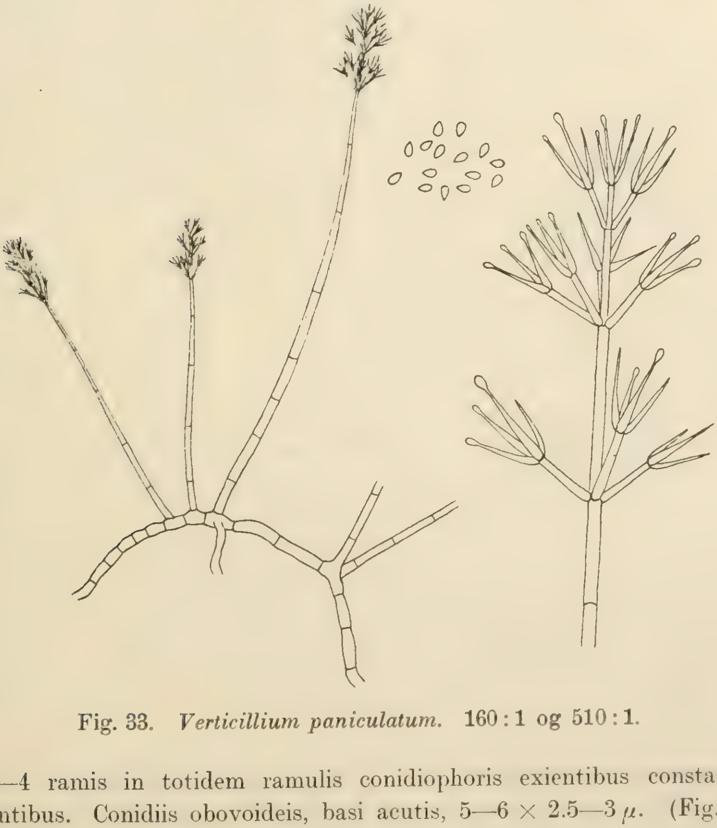

Fig. 33. *Verticillium paniculatum.* 160 : 1 og 510 : 1.

Ad radices *Piceae excelsae*. S. Bøndernes Hegn.

Fig. 34 viser en mærkelig Sammenvoksning mellem 2 Konidiebærere.

*__Verticillium glaucum__ Bon. Paa en død *Formica rufa*. S. Boserup Skov, Juli 1914.

*__Verticillium microspermum__ Sacc. Paa Lamellerne af en henraadnende Agaricacé. J. Dybdalskov, Juli 1891.

__Verticillium candidulum__ Sacc. Paa døde Naale af *Pinus silvestris*. S. Gelsskov 1911.

*__Verticillium cinnabarinum__ (Cda.) Reinke et Berth. Paa døde Korn af *Triticum vulgare* i Spireapparat. København.

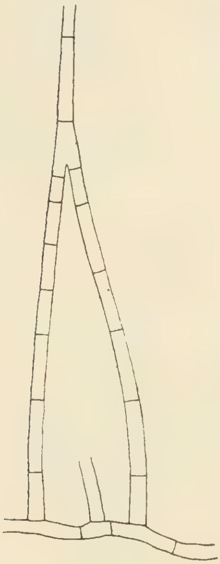

Fig. 34. *Verticillum paniculatum.* 2 sammenvoksede Konidiebærere. 190 : 1.

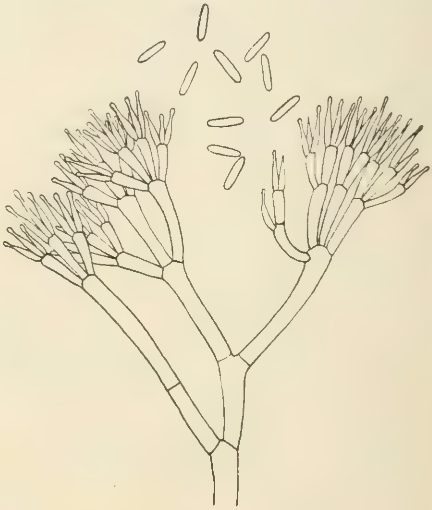

Fig. 35. *Acrocylindrium elegans.* 510 : 1.

*__Verticillium sulphurellum__ Sacc. Paa nedfaldne Frugter af *Quercus robur*. S. Jægersborg Dyrehave, Marts 1911.

*__Verticillium lutescens__ (Schw.) Sacc. Paa nedfaldne Frugter af *Acer pseudoplatanus*. S. Ermelunden, Febr. 1912.

*__Acrocylindrium elegans__ Bon. Paa nedfaldne Frugter af *Crataegus monogyna*. S. Jægersborg Dyrehave, April 1912. (Fig. 35).

Konidierne 7—9 × 2—2.5 $\mu$.

*__Spicaria nivea__ Harz. Paa raaddent Ved. S. Folehaven, Juni 1914.

*__Gonatobotrys simplex__ Cda. Vistnok alm. paa henraadnende Plantedele, f. Ex. Frø i Spireapparater. S. København, Lyngby, Holte, Farum Lillevang.

***Didymopsis perexigua** Sacc. et March. Paa *Cladosporium herbarum* paa døde Frugter af *Tragopogon pratensis* i Spireapparat. København, Juli 1910.

***Trichothecium candidum** Wallr. Paa *Polyporus brumalis*. S. Rude Skov, Okt. 1914.

**Diplocladium minus** Bon. Paa *Pleurotus ostreatus*. S. Jægersborg Dyrehave, Febr. 1913.

***Diplocladium tenue** n. sp. Caespitulis tenuibus, albis. Hyphis fertilibus erectis, septatis, apice 2—3 verticillos ternorum v. quaternorum ramorum aciculariorum, 30—50 × 3 $\mu$, gerentibus. Conidiis solitariis, oblongis v. cylindraceis, utrinque rotundatis, uniseptatis, ad septa non v. vix constrictis, hyalinis, 8—11 × 2.5 $\mu$. (Fig. 36).

Ad fructus putrescentes *Cucumeris sativi*. S. Lundby, Aug. 1913.

***Diplorhinotrichum affine** n. sp. Caespitulis perexiguis, albis. Hyphis fertilibus erectis, simplicibus, uniseptatis, 30—35 × 4 $\mu$, apice denticulatis; conidiis e denticulis oriundis, hyalinis, cylindraceo-clavatis, apice rotundatis, basi attenuatis, biloculatis, loculis omnibus 2—3-guttulatis, 16—25 × 4—5 $\mu$. (Fig. 37).

Ad samaras dejectas *Fraxini excelsioris* et *Aceris pseudoplatani*. S. Ermelunden, Maj 1911.

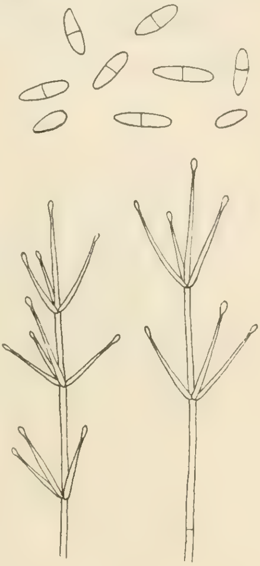

Fig. 36. *Diplocladium tenue*. Toppen af 2 Konidiebærere. 290:1. Foroven en Gruppe Konidier. 800:1.

Denne Art adskiller sig fra den eneste hidtil beskrevne *Diplorhinotrichum* (*D. candidulum* v. *Höhn.*) ved, at Konidiebærerne aldrig har mere end én Skillevæg, medens denne har 2—3, samt ved de lidt bredere og kun forneden tilspidsede Konidier.

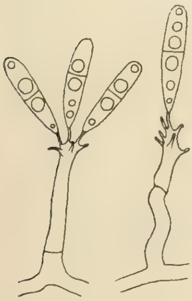

Fig. 37. *Diplorhinotrichum affine*. 560:1.

***Hormiactis fimicola** Sacc. et March. Paa nedfaldne Frugter af *Acer pseudoplatanus*. S. Ermelunden, Marts 1911. Paa Ræveekskrementer. S. Gelsskov, Dec. 1914.

***Septocylindrium album** (Preuss) Sacc. Paa døde Frø i Spireapparater. København.

***Septocylindrium virens** Sacc. Paa nedfaldne Frugter af *Fraxinus excelsior*. S. Rude Skov, Maj 1912.

**Dactylium dendroides** Fr. Paa *Stereum hirsutum*. S. Gelsskov, Okt. 1912.

***Monacrosporium subtile** Oud. Paa *Xylaria hypoxylon*. S. Hareskov, April 1914. Paa nedfaldne Naale af *Picea excelsa*. S. Gelsskov, Marts 1914.

***Monacrosporium sarcopodioides** (Harz) Berl. et Vogl. Paa nedfaldne

Frugter af *Fraxinus excelsior* og paa Bark af *Betula verrucosa*. S. Ermelunden, Nov. 1911.

Konidierne med 3—8 (hyppigst 6) Skillevægge, 45—50 $\mu$ l., 12 $\mu$ t.

***Monacrosporium elegans** Oud. Paa henraadnende Plantedele (nedfaldne Frugter af *Fagus*, *Fraxinus*, *Acer*, *Crataegus*, Bark af *Ulmus*, Ved af *Picea excelsa*) og paa Hjorteekskrementer. S. Ermelunden, Jægersborg Dyrehave, Hørsholm, Giesegaard, Foraar—Efteraar.

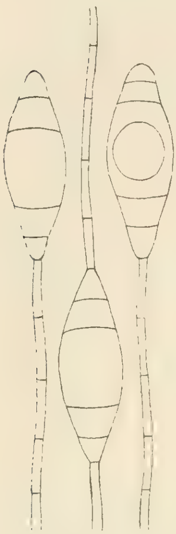

Fig. 38. *Monacrosporium elegans*. 560:1.

Der fandtes hyppigst 5-rummede Konidier; Fig. 38 viser 3 saadanne, af hvilke den ene er gennemvoxet.

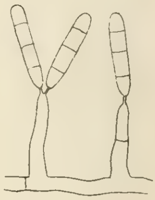

Fig. 39. *Dactylaria echinophila*. 560 : 1.

***Monacrosporium oxysporum** Sacc. et March. Paa nedfaldne Frugter af *Fraxinus excelsior*. Ermelunden, Nov. 1911.

Paa mine Eksemplarer varierede Skillevæggenes Antal mellem 6 og 11, medens SACCARDO og MARCHAL har 10—12.

***Dactylaria echinophila** Massal. Paa nedfaldne Frugter af *Fraxinus excelsior*. S. Ermelunden, Sept. 1911.

Konidiebærerne 25 $\mu$ h., 3.5 $\mu$ t., Konidierne 17—22 × 3,2—3.5 $\mu$, stedse med 3 Skillevægge. (Fig. 39).

**Helicomyces aureus** Cda. Paa nedfaldne henraadnende Grene. F. Alléskoven ved Faaborg, Okt. 1914. J. Sæbygaards Skov, Juli 1893.

***Helicomyces tubulosus** Riess. Paa raaddent Ved af *Quercus robur*. S. Ermelunden, Nov. 1888 (C. Raunkiær).

***Prismaria alba** Preuss (?). Paa en Konidiebærer af en ubestemmelig, mørkebrun Hyphomycet, voxende paa Naale af *Picea excelsa*. S. Gelsskov, Dec. 1913. (Tav. II, Fig. 15).

Om den af mig fundne Svamp er identisk med PREUSS' ovennævnte Art, er jeg noget i Tvivl om, da den foreliggende Beskrivelse er noget ufuldstændig og Afbildningen tilsyneladende noget skematisk.

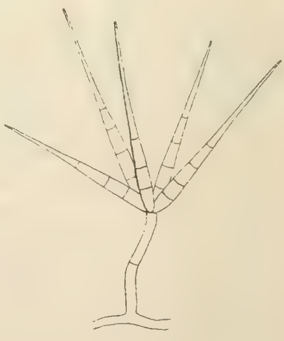

Fig. 40. *Dactylaria acicularis*. 560 : 1.

***Dactylaria acicularis** n. sp. Caespitulis oculo inarmato non cernendis. Hyphis fertilibus sparsis, erectis, septatis, 30—35 × 2.2 $\mu$, apice 3—6

conidia fusiformia, longe acutata, hyalina, 3—5-septata, 30—38 × 2.5 μ. gerentibus. (Fig. 40).

Ad excrementa *Armadillidii vulgaris* et ad samaras putridas *Fraxini excelsioris*. S. København, Ermelunden.

***Paraspora cidaris** n. sp. Caespitulis sparsis, perexiguis, subglobosis, quinquagenum fere conidiorum constantibus; conidiis oblonge-clavulatis v. cylindraceis, apice rotundatis, hyalinis, 3—7-septatis, 45-80 × 3-3.4 μ. (Fig. 41).

Ad corticem *Fagi silvaticae*. S. Frederikslund Skov, Okt. 1913.

***Trinacrium subtile** Riess. Paa døde Grene af *Betula*. S. Frederiksborg, Maj 1914.

**Titaea maxilliformis** Rostr. Paa Stængler af *Medicago sativa*. F. Hornemølle Gaard, April 1915.

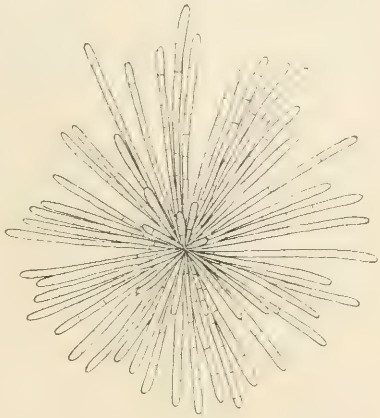

Fig. 41. *Paraspora cidaris*. 400 : 1.

## Dematiaceae.

**Coniosporium inquinans** Dur. et Mont. Paa Græsstraa. S. Jægerspris, Aug. 1903.

***Coniosporium aterrimum** (Cda.) Sacc. Paa døde Frø i Spireapparater. København.

***Stachybotrys lobulata** Berk. Paa døde Blade af *Quercus robur*. S. Gelsskov 1911.

**Periconia pycnospora** Fres. Paa døde Stængler af *Medicago sativa*. F. Hornemølle Gaard. Paa visne Blomster af *Ribes grossularia*. J. Balle ved Vejle, Aug. 1913.

**Periconia byssoides** Pers. Paa døde Stængler af *Medicago sativa*. S. Vemmetofte, Maj 1914.

**Arthrinium sporophleoides** Fckl. Paa Blade af *Carex Fraseri*. S. Hellebæk, April 1914 (F. Børgesen).

***Streptothrix fusca** Cda. Paa døde Stængler af *Pteridium aquilinum*. S. Gelsskov, Sept. 1890. Paa Frugter af *Fraxinus excelsior* i Spireapparat. København.

Konidierne 6.7—7 × 4 μ.

***Rhinocladium coprogenum** Sacc. et March. Paa henraadnende Straa af *Calamagr stis sp.* S. Rude Skov, Okt. 1914.

***Hormiactella fusca** (Preuss) Sacc. Paa nedfaldne Frugter af *Fraxinus excelsior*. S. Ermelunden, April og Sept. 1911.

Konidiebærerne 70—120 × 3.6 μ, de imellem disse staaende lodrette golde Hyfer 400—800 × 3.6—4.2 μ, Konidierne 15—17 × 2.5 μ.

***Botryotrichum piluliferum** Sacc. et March. Paa Ræveekskrementer. S. Gelsskov, Dec. 1914.

Konidierne 11—20 μ i Diameter.

***Mesobotrys macroclada** Sacc. Paa døde Blade af *Pinus silvestris* og *Quercus robur*. S. Gelsskov 1911.

***Menispora caesia** Preuss. Paa Indersiden af afsprængt Bark af *Acer pseudoplatanus*. S. Ermelunden, Juli 1915.

***Verticicladium acuum** Oud. Paa nedfaldne Naale af *Picea excelsa* og *Pseudotsuga Douglasii*. S. Gelsskov, Sept. 1914, Frerslev Hegn, Aug. 1915, Færgelunden, Juli 1915.

***Gonytrichum caesium** (Fr.) Sacc. Paa en nedfalden Gren af *Alnus glutinosa*. S. Folehaven, Maj 1914.

**Fuckelina microspora** Sacc. Paa raaddent Ved. S. Ravnsholt Hegn, Juli 1914.

***Chalara longipes** (Preuss) Cooke. Paa nedfaldne Naale af *Picea excelsa*. S. Gelsskov, Giesegaard, Marts 1914. Paa nedfaldne Frugter af *Quercus robur*. S. Charlottenlund, April 1914.

Konidiebærerne 90—100 × 6 μ, Konidierne 13—14 × 1.5 μ.

***Chalara gigas** n. sp. Caespitulis minutis, subfuscis. Hyphis fertilibus sparsis, paene aequicrassis, obscure fuscatis, 220—235 × 10 μ. Conidiis cylindraceis, hyalinis, 24—35 × 5 μ. (Tav. III, Fig. 18).

Ad corticem *Aceris pseudoplatani*. S. Ermelunden.

**Cladosporium sphaeroideum** Cooke. Paa *Aira caespitosa*. S. Folehaven, Juni 1905.

***Cladosporium lignicola** Cda. Paa Ved af *Quercus robur*. S. Krogenberg Hegn, Okt. 1893.

***Cladotrichum myrmecophilum** (Fres.) Lagerh. Denne Svamp, der synes knyttet til de af Myren *Lasius fuliginosus* byggede Reder, har jeg ogsaa konstateret i en saadan Rede, der findes i Landbohøjskolens zoologiske Samling og velvilligst af Prof. Boas blev overladt mig til Undersøgelse. Den er fundet under et Gulv i Stutterigaarden ved Strib 1909.

Om denne Svamp har Lagerheim skrevet en udførlig Afhandling i det svenske »Entomologisk Tidskrift«, 20. Aarg. S. 17 (1900).

**Arthrobotryum** n. gen. Hyphae steriles repentes; fertiles erectae, simplices, septatae, fuscae; hypharum articuli fertiles globosi, undique denticulato-sporigeri. Conidia obovoidea, didyma, hyalina.

***Arthrobotryum typicum** n. sp. Hyphis fertilibus sparsis, basi dilatatis, 4—7 verticillos conidiorum gerentibus, 150—235 × 3 μ. Conidiis obovoideis, hyalinis, 7—7.5 × 2.4 μ. (Tav. III, Fig. 19).

Ad semina putrescentia *Dactylidis glomeratae*. København, Marts 1913.

***Clasterosporium toruloides** (Cooke) Sacc. I Revnerne i stærk sprukken Bark af *Fagus silvatica*. S. Frederikslund Skov, Okt. 1913.

Antallet af Skillevægge i Konidierne (om hvilke Cooke kun siger, at der er mange) har jeg fundet varierende mellem 12 og 19, men omtrent Halvdelen af samtlige undersøgte Konidier havde 17. Størrelsen af Konidierne var 60—145 × 8—10 $\mu$. (Tav. III, Fig. 20).

***Septonema atrum** Sacc. Paa døde Grene af *Salix sp.* S. Tokkekøb Hegn, Maj 1891.

**Septonema secedens** Cda. Paa nedfaldne Frugter af *Fraxinus excelsior*. S. Ermelunden, Nov. 1913.

***Septonema effusum** n. sp. Caespitulis latius effusis, pulveraceis, nigris. Catenis conidiorum erectis, ramosissimis; conidiis cylindraceis, utrinque rotundatis, verruculosis, fuscatis, 3—4-septatis, ad septa constrictis, 16—24 × 5—6 $\mu$. (Tav. III, Fig. 21).

Ad semina putrescentia.

Paa »Frø« af *Beta*, *Fraxinus*, *Frangula*, *Negundo* og *Centaurea* i Spireapparat. København.

Denne Art ligner overmaade meget den af Berlese[1]) beskrevne *S. toruloides*, men adskiller sig ved, at alle Konidiernes Celler er fint vortede, og ikke alene den øverste. Min Art har ogsaa hyppigst 5-rummede Konidier, medens Berlese skriver »Les conidies sont ordinairement composées de 4 cellules« (S. 104) og i den latinske Diagnose »conidiis saepe 3—4-cellularibus« (S. 109), ligesom hans Tegning hyppigst viser 4-rummede Konidier; S. 106 skriver han ganske vist »les conidies divisées généralement par 4 cloisons transversales« og »la plus grande partie des conidies est munie de 4 cloisons«, men dette er sandsynligvis en Skrivefejl.

***Brachysporium hyalospermum** (Cda.) Sacc. Paa nedfaldne Blade af *Quercus robur*. S. Gelsskov 1911.

***Brachysporium longipilum** (Cda.) Sacc. Paa Indersiden af Bark af *Betula*. S. Ermelunden, Nov. 1914.

***Cercospora lythri** (West.) Niessl. Paa Undersiden af levende Blade af *Lythrum salicaria*. S. Gelsskov, Sept. 1914.

**Heterosporium gracile** (Wallr.) Sacc. Paa Blade af *Iris Monnieri*, *I. ochroleuca* og *I. daënensis*. Botanisk Have i København, 1888.

***Heterosporium syringae** Oud. Paa levende Blade af *Syringa vulgaris*. København, Aug. 1914.

***Acrothecium bulbosum** Sacc. Paa Ved af *Picea excelsa*. S. Gelsskov, Marts 1914.

**Acrothecium obovatum** Cooke. Paa raaddent Ved. S. Gelsskov, Maj 1891.

[1]) Bull. d. l. Soc. myc. de France 1892, S. 103.

***Acrothecium apicale** (B. et Br.) v. Höhn. Paa en raadden Gren af *Fagus silvatica*. S. Jægersborg Dyrehave, Aug. 1914.

***Dendryphium Ellisii** Cooke. Paa raaddent Ved. S. Jægersborg Dyrehave, April 1903.

***Dendryphium arbuscula** (Preuss) Sacc. Paa Frugter af *Carpinus betulus* (avlede i København) i Spireapparat, Marts 1912. Paa Stængler af *Angelica silvestris*. S. Hareskov, Juli 1913. (Tav. III, Fig. 22).

Da Preuss' Beskrivelse er meget kortfattet, skal jeg supplere den med følgende: Konidiebærerne 120 × 9 μ, Konidierne med 6—9 Skillevægge, fint vortede, 57—70 × 11—14 μ, sortebrune men lidt lysere mod begge Ender. Ligner overordentlig meget *D. rhopaloides* (Fres.) Berl., men denne Arts Konidier er glatte.

**Dendryphium toruloides** (Fers.) Sacc. Paa døde Stængler af *Medicago sativa*. S. Vemmetofte, Maj 1914.

***Coniothecium Mughi** Oud. Paa døde Grene af *Larix leptolepis*. J. Benzon, April 1914.

**Coniothecium complanatum** (Fr.) Sacc. Paa Grene af *Corylus avellana*. S. Ordrup Mose, April 1905.

**Coniothecium applanatum** Sacc. Paa Grene af *Salix alba*. København, Maj 1891. Paa *Salix lanceolata*. S. Charlottenlund, Juni 1891.

***Dictyosporium secalinum** Delacr. Paa Rødder af *Avena sativa*. S. Lundby, Aug. 1913.

**Speira toruloides** Cda. Paa døde Naale af *Picea excelsa*, *Pinus silvestris* og *P. nigra*. S. Gelsskov 1911.

***Speira inops** Bomm., Rouss. et Sacc. Paa henraadnende Ved af *Picea excelsa*. S. Giesegaard, April 1914.

**Tetraploa aristata** B. et Br. Paa visne Græsstraa. S. Hareskov, Maj 1903.

***Stemphylium piriforme** Bon. Paa døde Frø i Spireapparater. København.

***Stemphylium macrosporioideum** (B. et Br.) Sacc. Paa døde Frø i Spireapparater. København.

***Stemphylium polymorphum** Bon. Paa døde Frø i Spireapparater. København.

***Stemphylium sphaerospermum** (Preuss) Sacc. Paa nedfaldne Frugter af *Crataegus monogyna*. S. Jægersborg Dyrehave, Nov. 1913.

Karakteristisk ved sit udbredte, rustgule-rustbrune Mycelium. Konidierne 17—27 μ i Diameter.

***Helicosporium phragmitis** v. Höhn. Paa henraadnende Straa af *Arundo phragmites*. S. Furesøen, Juli 1914.

***Helicoon politulum** (Schulzer) Lindau. Paa nedfaldne Frugter af *Acer pseudoplatanus*. S. Ermelunden 1911.

Om den af mig fundne *Helicoon* er identisk med Schulzers, kan jeg ikke aldeles sikkert afgjøre, da S. ingen Maal har angivet. Konidierne paa mine Eksemplarer bestod af 5—8 Vindinger, der dannede en cylindrisk Spiral, 26 $\mu$ høj og 19 $\mu$ i Gennemsnit; selve Konidien var 3.5 $\mu$ tyk.

**Triposporium elegans** Cda. Paa raaddent Ved. S. Frederiksdal Storskov, Maj 1891, Ravnsholt Hegn, Juli 1914.

## Stilbaceae.

***Stilbella villosa** (Fr.) Lindau. Paa Ræveekskrementer. S. Gelsskov, Dec. 1914.

***Stilbella candida** (Fckl.) Lindau. Paa Løg af *Tulipa*. S. Charlottenlund, Juni 1914. Paa henraadnende Bladstilke af *Helleborus niger*. København, Sept. 1914.

***Coremium arbuscula** H. Fisch. Fra en »Luftprøve«. København, April 1913.

***Sporocybe byssoides** Fr. Paa raadne Havrestraa. S. Lundby, Aug. 1913.

***Graphium stilboideum** Cda. Paa Ekskrementer af *Armadillidium vulgare*. København, Aug. 1913.

Eksemplarerne var kun c. ½ mm høje (Lindau skriver »kaum 2 mm hoch«).

***Graphium stercorarium** March. Paa raaddent Ved af *Picea excelsa*. S. Gelsskov, Nov. 1913.

Da Marchals Beskrivelse i et og alt passer paa den af mig fundne Svamp, maa jeg identificere denne med hans Art, som ellers kun er fundet paa Ekskrementer og »supra telam stercoratam«.

Fig. 42. *Stysanus stemonites*. 50 : 1.

**Graphium rigidum** (Fr.) Sacc. Paa Bark af *Picea excelsa*. S. Giesegaard, Marts 1914.

***Graphium piliforme** Fr. Paa døde Frø i Spireapparater. København.

Hele Svampen naar en Højde af 200—500 $\mu$, og Stilkens Tykkelse er 7—20 $\mu$, Konidierne langstrakt ellipsoidiske eller cylindriske, 8—11 $\times$ 3 $\mu$ med en Oliedraabe i hver Ende.

***Graphium penicillioides** Cda. Paa »Frø« af *Lolium temulentum* i Spireapparat. København. Paa Bark af *Acer pseudoplatanus*. S. Jægersborg Dyrehave, Nov. 1913.

**Stysanus stemonites** Fr. Fig. 42 viser et gennemvokset og grenet Individ, fremkommet paa et Ræveekskrement.

***Stysanus microsporus** Sacc. Paa henraadnende Straa af *Avena sativa*. S. Lyngby, Maj 1915.

***Stysanus capitatus** Rke. et Berth. Paa raadne Straa af *Avena sativa*. S. Lyngby, Sept. 1913. Paa Blade af *Quercus robur*. S. Gelsskov 1911.

***Stysanus cybosporus** D. Sacc. Paa nedfaldne Frugter af *Negundo californicum*. København, Dec. 1914.

***Stysanus verrucosus** Oud. Paa døde Frø af *Pinus silvestris* og *Dactylis glomerata* i Spireapparat. København, Nov. 1887. Paa henraadnende Straa af *Avena sativa*. S. Lyngby. Paa nedfaldne Blade af *Fagus silvatica*. S. Gelsskov.

Naar GUÉGUEN[1]) skriver: »Le *Stysanus verrucosus*, décrit par M. OUDEMANS, .... me semble se confondre avec le précédent *(Echinobotryum atrum)*«, er jeg ikke i Tvivl om, at han tager fejl.

## Tuberculariaceae.

**Tubercularia brassicae** Lib. Paa henraadnende Stokke af *Brassica oleracea*. J. Nebsager, Dec. 1891.

**Illosporium roseum** Fr. Paa *Ramalina polymorpha*. København, April 1908.

***Fusicolla foliicola** Krst. Paa nedfaldne Frugter af *Acer pseudoplatanus*. S. Ermelunden, April 1911.

**Sphaeridium vitellinum** Fres. Paa nedfaldne Frugter af *Crataegus monogyna*. S. Jægersborg Dyrehave, Juni 1913.

**Volutella gilva** (Fr.) Sacc. Paa Stængler af *Medicago sativa*. F. Horne, Maj 1915.

***Volutella carnea** (Preuss) Sacc. Paa døde Frø i Spireapparater. København.

***Fusarium culmorum** W. G. Smith (= *F. rubiginosum* App. et Woll.) Paa — især »fodsyge« Individer af — *Secale cereale*, *Triticum sativum*, *Hordeum sativum*, *Avena sativa*, *Dactylis glomerata*. S. Lyngby, Taastrup, Skullerupholm, Ringsted, Tystofte, L. Søllested, Ærø: Skovby, J. Studsgaard, Levring, Kvistrup, Tingskov, Bornh. Vang. Alm. paa døde Frø i Spireapparater af *Secale*, *Triticum*, *Hordeum*, *Avena sativa* og *elatior*, *Lolium temulentum*, *Alopecurus pratensis*, *Phalaris arundinacea*, *Festuca ovina*, *Bromus hordeaceus*.

***Fusarium subulatum** App. et Woll. Paa »fodsyge« Individer af *Secale cereale*, *Triticum sativum*, *Avena sativa*, *Bromus arvensis*. S. Uglerup, Tystofte, Stevns, J. Studsgaard, Skanderborg, Askov, Kolding. Paa døde Frø i Spireapparater af *Secale*, *Triticum*, *Festuca ovina*, *Sinapis alba*.

***Fusarium metachroum** App. et Woll. Paa døde Frø i Spireapparater af *Secale*, *Triticum*, *Hordeum*, *Avena sativa* og *elatior*, *Lolium perenne* og

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[1]) Bull. d. l. soc. myc. de France 1903, S. 238.

*italicum, Phleum pratense, Phalaris arundinacea, Festuca pratensis* og *ovina, Dactylis, Beta, Spergula, Platanus, Daucus, Petroselinum, Onobrychis, Ornithopus, Trifolium pratense, Plantago lanceolata, Lappa minor.*

***Fusarium falcatum** App. et Woll. Paa Kimplanter af *Matthiola*, dræbte af *Pythium Debaryanum*. J. Aale, Juni 1913.

***Triglyphium album** Fres. Paa Bark af *Quercus robur*. S. Ermelunden, April 1915. (Fig. 43).

***Chaetostroma atrum** Sacc. Paa visne Straa af *Dactylis glomerata*. F. Middelfart, Maj 1914.

***Myrothecium inundatum** Fr. Paa Lamellerne af en indtorret *Agaricacé*. S. Rude Skov.

**Spegazzinia ammophilae** Rostr. Paa Græsstraa. S. Furesoen, Maj 1914.

***Stephanoma italicum** (Speg.) Sacc. et Trav. Denne ejendommelige Svamp, der paa Grund af Sporernes Bygning oprindelig blev henført til Brandsvampene[1]) under Navnet *Urocystis italica*, blev først fundet paa Frugter af *Castanea vesca* i Italien og derpaa i Argentina. Senere fandt F. W. Neger[2]) den paa Agern fra Slavonien, og ved at undersøge dens Udvikling kommer han til det Resultat, at den sandsynligvis maa henføres til Hyphomyceterne. I en nyere Afhandling af samme Forf. »Uber *Urocystis*-ähnliche Nebenfruchtformen von Hypocreaceen«[3]), i hvilken han foruden foreliggende omtaler 3 andre meget lignende Arter, af hvilke det er lykkedes ham at paavise, at den ene er Konidieformen til *Melanospora marchica* Lindau, udtaler han den Formodning, at de alle er Konidieformer af Hypocreaceer, men han giver dem stadig intet nyt Navn. I 20. Bd. af »Sylloge fungorum« (1911, S. 887) henføres de endelig til Slægten *Stephanoma*, hvad jeg dog næppe kan tro vil blive Svampens endelige Plads i Systemet, der forekommer mig at maatte søges blandt Dematiaceae og ikke blandt Tuberculariaceae.

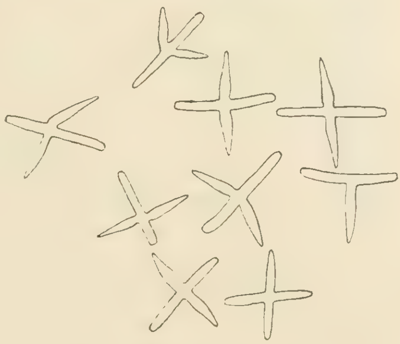

Fig. 43. *Triglyphium album.* Konidier 560 : 1.

Paa Frugter af *Quercus robur* af dansk Avl i Spireapparat. København 1892.

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1) Spegazzini er dog straks i Tvivl om det rigtige heri, idet han skriver: »Species ab Ustilagineis satis abhorrens, sed ad interim adhuc inter illas numeranda«.

2) Tharander Forstl. Jahrb. 1909, S. 238.

3) Myc. Centr. 4. Bd., S. 273.

## Mycelia sterilia.

***Sclerotium hydrophilum** Sacc. Denne af W. ROTHERT[1]) meget udførligt beskrevne Svamp, der adskiller sig fra de fleste andre kendte Sklerotier ved ikke at frembringe nogen Art Frugtlegemer med Sporer men udsende Hyfer, der umiddelbart danner ny Sklerotier, fandt jeg i stor Mængde svømmende i Vandet eller siddende paa forskellige *Lemna*-Arter i Utterslev Mose i Maj 1913. Senere har jeg fundet den i Fuglesangsoen mellem *Equisetum*-Stængler, ligeledes i Maj Maaned.

***Sclerotium mucor**. Under dette Navn beskrev og afbildede H. I. TODE i 1790[2]) en Svamp, som jeg tror at have genfundet. Hans Beskrivelse lyder saaledes: »S. ellipticum, decumbens, aggregatum. . . . . Granis siligineis quoad figuram similis fungus tam parvus est, ut aciem oculorum vulgarem facile effugiat. Color cutis fulvus, fuscescens; substantiae albus. Gregatum in festucis, frustulisque lignorum crescit aprili, perrarus«. Denne Beskrivelse og hans Figur passer nøje paa nogle smaa, sklerotieagtige Legemer, som jeg gentagne Gange har stødt paa og omstaaende bringer nogle Afbildninger af (Tav. III, Fig. 23 og 24). Barklaget bestaar af brunfarvede, parallelt løbende Hyfer, der strækker sig fra Pol til Pol af det tenformede Legeme og ved Tryk falder fra hinanden ganske som Staverne i en Tønde, og Marven dannes af temmelig løst sammenvævede, hyaline, uregelmæssig forgrenede Hyfer. Som unge er Sklerotierne omgivne af nogle faa hvide Haar, der udgaar fra den nedre Ende. Jeg har længe haft disse Sklerotier liggende paa fugtigt Filtrerpapir, men nogen Spiring fandt ikke Sted. Deres Størrelse er 240—260 $\mu$.

Fremkommet i Stuekulturer paa Stængler af *Equisetum fluviatile* og *Avena sativa*, paa Frugter af *Hordeum* og *Alnus*. København 1913 og 1914.

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[1]) Bot. Zeit. 1892, S. 321.

[2]) Fungi mecklenburgenses I, S. 5.

# Contributions to the Fungus-flora of Denmark. I.

By **Ove Rostrup.**

(Abstract).

The preceding paper is chiefly a list of fungi which are new to (marked with *) or rare in Denmark or have been found on a substratum (plant or animal) on which they have not been observed formerly in this country.

Of the contents are to be quoted here:

New species:

**Mortierella globulifera.** On horse-dung. Diagnosis and fig. 1 p. 2.

**Calonectria pellucida.** On awns of *Dactylis glomerata.* Diagnosis and fig. 7 p. 8.

**Rhyncophoma fulica.** On capsules and seeds of *Plantago lanceolata.* Diagnosis and fig. 17 p. 30.

**Stagonospora megistospora.** On stalks of *Scirpus lacustris.* Diagnosis and fig. 18 p. 31.

**Hendersonia equisetina.** On stalks of *Equisetum fluviatile.* Diagnosis p. 31; t. II, fig. 14.

**Septoria brachypodina.** On leaves of *Brachypodium silvaticum.* Diagnosis and fig. 20 p. 32, t. III, fig. 17.

**Eriospora achaenioides.** On downfallen fruits of *Fraxinus excelsior.* Diagnosis and fig. 21 p. 33.

**Briarea aurosa.** On paper. Diagnosis and fig. 28 p. 38.

**Sporotrichum Kirchneri.** On *Tarsonemus spirifex.* Diagnosis and fig. 29 p. 39.

**Sporotrichum fimicola.** On dogs' excrements. Diagnosis and fig. 30 p. 40.

**Pachybasium niveum.** In sandy ground. Diagnosis and fig. 32 p. 41.

**Verticillium paniculatum.** On roots of *Picea excelsa.* Diagnosis and fig. 33—34 p. 41.

**Diplocladium tenue.** On decaying fruits of *Cucumis sativus.* Diagnosis and fig. 36 p. 43.

**Diplorhinotrichum affine.** On downfallen fruits of *Fraxinus* and *Acer*. Diagnosis and fig. 37 p. 43.

**Dactylaria acicularis.** On downfallen fruits of *Fraxinus* a. o. Diagnosis and fig. 40 p. 44.

**Paraspora cidaris.** On bark of *Fagus silvatica*. Diagnosis and fig. 41 p. 45.

**Chalara gigas.** On bark of *Acer pseudoplatanus*. Diagnosis p. 46; t. III, fig. 18.

**Arthrobotryum typicum.** On seeds of *Dactylis glomerata*. Diagnosis p. 46; t. III, fig. 19.

**Septonema effusum.** On rotten seeds in germinating apparatus. Diagnosis p. 47; t. III, fig. 21.

More interesting species which formerly have been found only once or a few times or which have been found on a new substratum:

**Mucor proliferus** Schostakow. On horse-dung.

**Empusa sciarae** Edgar W. Olive. In great quantity on *Sciara sp.* Fig. 2 p. 3.

**Basidiobolus ranarum** Eidam. On excrements of *Rana* and *Bufo*.

**Eremascus albus** Eidam. On decaying fruits of *Daucus carota*.

**Myxotrichum brunneum** Rostr. In a pupa of *Amphidasys betularius*.

**Aspergillus nidulans** Eidam. Common on dead seeds in germinating apparatus.

**Anixiopsis stercoraria** Hans. On foxes excrements.

**Onygena corvina** Fr. On toe-nails of man. Fig. 5 p. 6.

**Eumonoicomyces papuanus** Thaxt. On *Oxyteles rugosus*. Fig. 9 p. 10.

**Laboulbenia flagellata** Peyr. On *Anchomenus albipes* and *A. Krynickii*. T. I, fig. 2.

**Laboulbenia pterostichi** Thaxt. On *Pterostichus nigrita* and *P. strenuus*. T. I, fig. 3.

**Pleurage verruculosis** C. N. Jens. On »foot-diseased« specimens of *Avena sativa*.

**Ceratostoma caulincola** Fckl. On fruit-shells and cotyledons of *Quercus robur*. T. I, fig. 5.

**Exobasidium mycetophilum** (Peck) Burt. On *Collybia dryophila*.

**Hirsutella entomophila** Pat. On *Ptinus rufipes*. Fig. 14 p. 25.

**Coronella nivea** Crouan. On foxes excrements.

**Cylindrocephalum lycopotrum** (Preuss)! On downfallen fruits of *Fraxinus excelsior*. Fig. 27 p. 37.

**Prismaria alba** Preuss (?). On a species of Hyphomycetes growing on leaves of *Picea excelsa*. T. II, fig. 15.

**Trinacrium subtile** Riess. On dead branches of *Betula*.

**Helicoon politulum** (Schulzer) Lindau. On downfallen fruits of *Acer pseudoplatanus.*

**Stysanus verrucosus** Oud. On dead seeds of *Pinus* and *Dactylis* in germinating apparatus. Is without doubt a good species what Guéguen doubts.

**Triglyphium album** Fres. On bark of *Quercus robur.* Fig. 43 p. 51.

**Stephanoma italicum** (Speg.) Sacc. et Trav. On fruits of *Quercus robur.*

**Sclerotium mucor.** This by Tode in 1790 described fungus I believe to have found again in room-cultures on stalks of *Equisetum fluviatile* and on fruits of *Hordeum* and *Alnus.* t. III, fig. 23 and 24.

Further are to be mentioned:

**Empusa Fresenii** Now. Numerous *Aphis papaveris* entirely full of resting-spores.

**Entomophthora sphaerosperma** Fres. An epidemic on imago of *Agriotes lineatus* in the vicinity of Aarhus.

**Microascus Schumacheri** (Hans.)! *Microascus sordidus* Zuk. is synonymous with the *Sphaerella Schumacheri* described by E. Chr. Hansen in 1876.

**Calonectria belonospora** Schroet. A double-ascus is shown in fig. 6 p. 8.

**Claviceps purpurea** (Fr.) Tul. Some experiments with sclerotia originating from different species showed that some (from *Secale, Molinia coerulea, Arundo phragmites*) all germinated the first spring after sowing in autumn, while of others (from *Phalaris arundinacea, Festuca gigantea, Dactylis glomerata*) there were some which did not germinate till the second spring after sowing. It is to be observed that the sclerotia had been exposed to the influence of the frost during the winter. Regarding the number of sporophores on the sclerotia of the different species tab. 2 p. 9 gives information.

**Rehmiellopsis abietis** (E. Rostr.)! In 1902 E. Rostrup described under the name *Sphaerella abietis* a fungus on leaves of *Abies spp.*, a species which was described again in 1910 by Bubák and Kabát under the name of *Rehmiellopsis bohemica.* As in having more than 8 spores in every ascus it differs from the genus *Sphaerella* it may be right to base a new genus on it, but the specific name »abietis« it must retain.

**Rhopographus filicinus** (Fr.) Nke. The spores of this species are commonly stated to have »3 (rarely 5)« septa. In one locality the condition was found to be considerably different from the normal state, as only 62 p.ct. of the spores had 3 septa while 7 p.ct. had 4, 18 p.ct. 5, 7 p.ct. 6 and 6 p.ct.

7 septa. Also the dimensions of the spores were here considerably larger than usual.

**Sclerotinia scirpicola** Rehm. T. II, fig. 8 shows a specimen with one stem and 2 ascomata.

**Leotia marcida** Fr. T. II, fig. 9 shows a specimen with bipartite stem.

**Phragmidium rubi-idaei** (Pers.) Krst. The number of loculi in the teleutospores is very variable. A sample showed

| | | | | |
|---|---|---|---|---|
| 2 | p.ct. | with | 4 | loculi |
| 33 | — | — | 5 | — |
| 58 | — | — | 6 | — |
| 7 | — | — | 7 | — |

while the average for 10 other localities was:

| | | | | |
|---|---|---|---|---|
| 0.3 | p.ct. | with | 4 | loculi |
| 5.4 | — | — | 5 | — |
| 25.0 | — | — | 6 | — |
| 39.2 | — | — | 7 | — |
| 26.0 | — | — | 8 | — |
| 4.0 | — | — | 9 | — |
| 0.1 | — | — | 10 | — |

See tab. p. 23.

T. II, fig. 10 shows a misformed spore.

**Craterellus cornucopioides** Fr. T. II, fig. 11 shows a misformed specimen.

**Typhula gyrans** Fr. During an experiment it appeared, that the speed of germination stood in an inverse ratio to the specific gravity (see tab. p. 25).

**Polyporus obliquus** Fr. A specimen extending c. 12 metres on a stem of *Fagus silvatica*.

**Phallus impudicus** Pers. Fig. 15 p. 27 shows a monstruous specimen.

**Marssonina potentillae** (Desm.) Magn. Fig. 23 and 24 (p. 34 and 35) shows variations in shape and size of the spores within this species.

Tavle I.

# Tavle I.

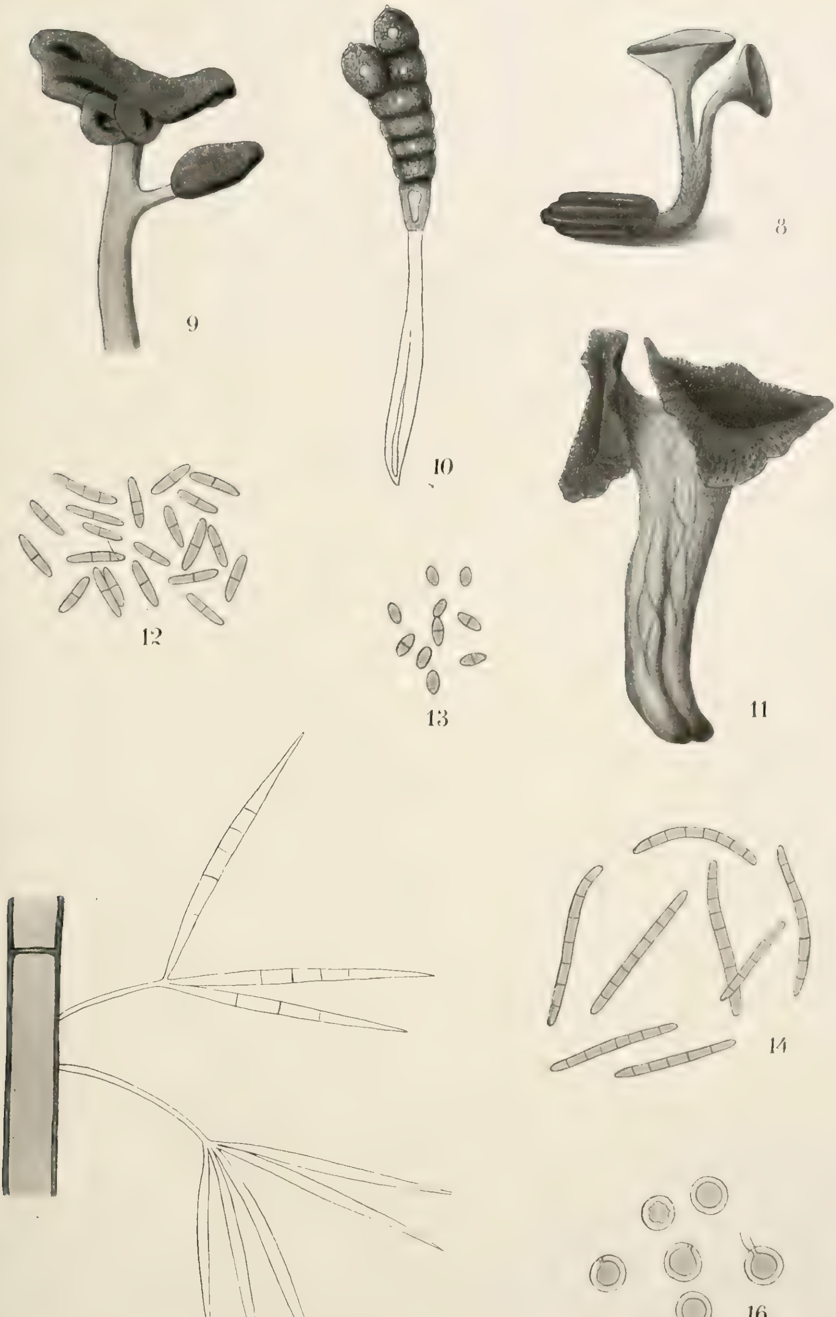
Fig. 1. *Empusa Fresenii.* Laar af en Bladlus indeholdende 31 Hvilesporer. 260 : 1.
— 2. *Laboulbenia flagellata.* 190 : 1.
— 3. *Laboulbenia pterostichi.* 190 : 1.
— 4. *Sordaria curvula.* 50 : 1.
— 5. *Ceratostoma caulincola.* Sporer 400 : 1.
— 6. *Pleospora vulgaris.* 4 Sporesække fra samme Sporehus 560 : 1.
— 7. *Rehmiellopsis abietis.* Naal af *Abies alba* med Sporehuse 3.5 : 1.


O. Rostrup del.

Tavle II.

# Tavle II.

Fig. 8. *Sclerotinia scirpicola.* 2 : 1.
— 9. *Leotia marcida.* 3.5 : 1.
— 10. *Phragmidium rubi-idaei.* En anormal Teleutospore 270 : 1.
— 11. *Craterellus cornucopioides.* Lidt formindsket,
— 12. *Microdiplodia pterophila.* Konidier 560 : 1.
— 13. *Microdiplodia microsporella.* Konidier 560 : 1.
— 14. *Hendersonia equisetina.* Konidier 400 : 1.
— 15. *Prismaria alba.* 560 : 1.
— 16. *Aspergillus varians.* 290 : 1. Se Teksten.

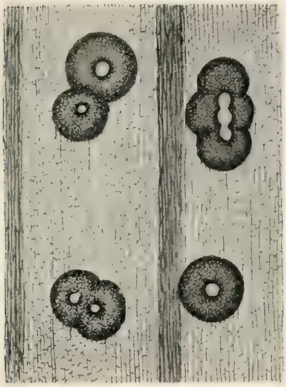



O. Rostrup del.

Tavle III.

# Tavle III.

Fig. 17. *Septoria brachypodina.* Et Bladstykke med Pyknider 75 : 1.
— 18. *Chalara gigas.* 160 : 1.
— 19. *Arthrobotryum typicum.* 560 : 1.
— 20. *Clasterosporium toruloides.* Konidier 400 : 1.
— 21. *Septonema effusum.* 480 : 1.
— 22. *Dendryphium arbuscula.* 260 : 1.
— 23. *Sclerotium mucor.* 6 : 1.
— 24. *Sclerotium mucor.* En Ende af Sklerotiet, af hvilket noget af Indholdet er trykket ud. 800 : 1.



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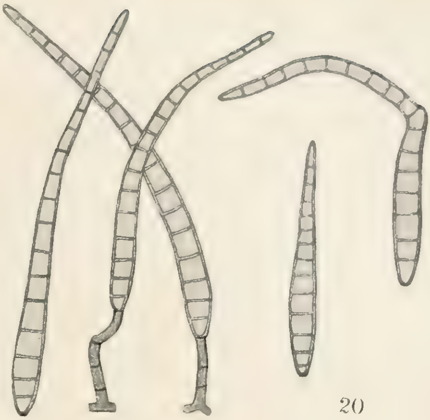

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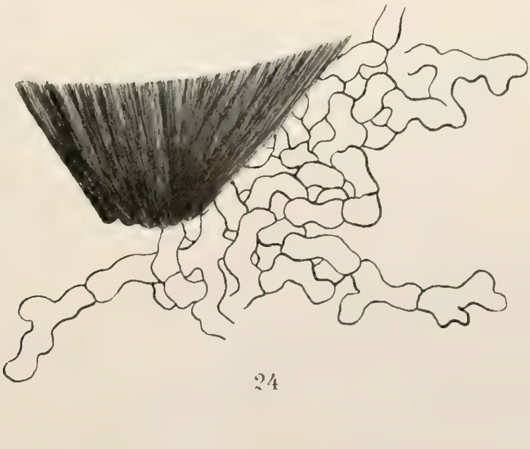

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*O. Rostrup del.*

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UDGIVET AF DANSK BOTANISK FORENING
1916

# Contributions to West Australian Botany.

By
**C. H. Ostenfeld.**

## Part I.

(Introduction. — The Sea-grasses of West Australia, by **C. H. Ostenfeld**).

## Introduction.

In June 1914 I visited Australia in response to an invitation from "the British Association for the Advancement of Science" to take part in the annual meeting to be held in the capitals of the different States of the Commonwealth of Australia. An accident during the voyage prevented me from fulfilling my original purpose. I was laid up in Perth, West Australia, during the period of the meeting, and it was not until later that I was able to utilise my sojourn in a country which from a botanical point of view is amongst the most interesting.

The Government of West Australia many years ago had the foresight to secure a forest area of about 1000 acres on Mount Eliza just outside the capital overlooking Perth Waters, and to make it into a nature reserve under the name of Kings Park. Except a small portion close to the main entrance where the ground has been changed into an artificial park with foreign plants, the whole area is left practically untouched though it is intersected by several drives and footpaths. The natural vegetation remains, especially the shrubs and herbaceous plants, and there is still a considerable number of forest trees[1], mostly Jarrah (*Eucalyptus marginata*) and Red Gum (*E. calophylla*). The park is under the control of a board which wisely has prohibited any

[1] The best timber trees were removed before the park was reserved.

collecting of flowers there, and thanks to this there is a profusion of flowers covering the ground in the spring.

The study of this natural reserve gave me a splendid introduction to the rich and peculiar flora of West Australia, and the authorities greatly facilitated my studies by granting a special permit for collecting.

From Perth I made several trips by rail to more or less distant parts of the State: — to Armadale and Mundaring Weir to study the flora of the western slopes of the Darling Range, to Bayswater and Cannington for the plants of the alluvial plains, and to Cottesloe (near Fremantle) for the strand flora. I made an interesting excursion to the Cave District (Yallingup Cave) in the south-west corner of the state, and travelled by rail to Bridgetown and Big Brook State Mill to obtain some impression of the Karri forest (*Eucalyptus diversicolor*) the most luxuriant plant growth in the State. Later on I paid a flying visit to Albany on King George's Sound to see the "pitcher plant" (*Cephalotus follicularis*) in its native habitat along with the otherwise rich flora of this botanically classical place. In order to become acquainted with the flora of the arid interior I visited Tammin on the way to Kalgoorlie, and also the famous mining-town Kalgoorlie itself with its semi-desert surroundings.

These excursions were planned to obtain what I should call selected samples of the different kinds of vegetation occurring in the south-western part of the State.

As I was interested in obtaining some idea of the vegetation of the more tropical parts of West Australia, I decided to leave the State by means of a coasting steamer which runs from Fremantle to Java, calling at a good many places along the north-western and northern coast of West Australia. Thus I visited Geraldton, Carnarvon, Point Sampson, Port Hedland, Broome and Derby and had an opportunity of seeing the vegetation of these tracts and of making collections.

My stay in West Australia lasted from August to the end of October, the best time of the year as regards the plant world; and I brought home a fairly large collection (mostly herbarium plants), the study of which will occupy some time.

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The flora of West Australia is fairly well known. The main sources are BENTHAM's *Flora Australiensis* and the publications by

Diels and Pritzel [1] in which all the earlier literature has been quoted. A very useful list of the flora has been published in the State Yearbook for 1900—1901 [2], and a periodical issued in Perth by a scientific society which goes under various names ("The Mueller Botanic Society", "The West Australian Natural History Society", "The Natural History and Science Society of W. A.") contains several papers on the flora (1902—1914).

Valuable contributions have also been made by Spencer Le Marchant Moore (Journ. Linnean Soc., Botany, XXXIV, 1899) as the result of travels in the interior of the state, and by K. Domin (ibid., XLI, 1912) who has worked out some recent collections from West Australia preserved in the Kew Herbarium. Isolated minor contributions to West Australian Botany are to be found in the Kew Bulletin and other British periodicals, in Fedde's *Repertor. novar. spec.*, in K. Domin's important work; Beitr. zur Flora und Pflanzengeographie Australiens (1915—), and in the journals of various Australian scientific societies.

As regards the phytogeography our main source is the monograph by L. Diels (1906) dealing with the extra-tropical part of the State. Shorter sketches of the vegetation have been published by A. Morrison (in the State Yearbook for 1900—1901) and by C. Andrews (in the Handbook of W. A., prepared for the members of the British Association for the Advancement of Science, 1914).

From this summary of the earlier studies on West Australian botany it is evident that any contributions of mine resulting from journeys mostly within areas previously visited by botanists, must be relatively unimportant. A longer stay in the tropical part of the State would have been a great opportunity, since the flora and vegetation of this part are very poorly investigated [3]. The future botanical exploration of the north-western and the tropical

[1] L. Diels and E. Pritzel: Fragmenta Phytographiæ Australiæ occidentalis. — Engler, Botan. Jahrb., XXXV, 1904—05.

L. Diels: Die Pflanzenwelt von West-Australien südlich des Wendekreises. — Engler u. Drude, Die Vegetation der Erde. VII. 1906.

[2] F. von Mueller: List of Extra-tròpic West Australian Plants. Revised and augmented by A. Morrison. — Western Australian Year-Book for 1900—1901, vol. I. Perth 1902.

[3] After this was written I received a valuable contribution to the flora of the tropical W. A., viz.: E. Cheel: Plants, in: Results of Dr. E. Mjöbergs Swedish scientific Expeditions to Australia 1910—13. K. Svenska Vetensk. Akad. Handl. Bd. 52, No. 10. Stockholm 1916.

parts of West Australia will certainly produce interesting results both floristic and phyto-geographic.

Yet the richness of the flora of the south-western part of the State is so great that my collections and observations contain some additions to our knowledge. These I propose to publish as a short series of contributions.

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I should like to use this opportunity to acknowledge the extreme kindness extended to me by the Government of West Australia and by several persons, amongst whom I wish especially to mention the Hon. W. Kingsmill, M. L. C.; Mr. Cecil Andrews, Director of Education; Mr. W. Catton Grasby, Editor of the Western Mail; Professor and Mrs. W. J. Dakin; Mr. Bernard H. Woodward, Director of the Perth Museum; Mr. W. B. Alexander, Keeper of Biology, Perth Museum; Mr. O. H. Sargent, Chemist at York; Mr. R. Strelitz, then Royal Danish Consul; and Mr. Fred. A. Hadley, my excellent doctor. I am also specially indebted to my good friend Mrs. Miriam Davis, proprietress of the St. Omer Hospital, who assisted me in collecting in every possible way, and from whom I have later received a valuable collection of herbarium specimens and seeds. My countryman Mr. Erik Dorph-Petersen also contributed greatly by bringing me numerous specimens of plants from the neighbourhood of Perth.

# The Sea-Grasses of West Australia.

By

C. H. Ostenfeld.

## General Remarks.

The name "sea-grasses" is here used to designate the few Flowering Plants, which live in sea water and are unable to exist in fresh or nearly fresh water. Thus I exclude by this definition the brackish water genera, such as *Zannichellia*, *Ruppia*, *Althenia* and *Lepilaena* and limit the group to the following genera: *Halophila*, *Enhalus* and *Thalassia* of the *Hydrocharitaceæ; Cymodocea*, *Diplanthera (Halodule)*, *Zostera*, *Phyllospadix* and *Posidonia* of the *Potamogetonaceæ*. The number of species of sea-grasses known does not much exceed 30. Some of them have very wide areas of distribution, others rather limited.

As to Australia, about 13 species belonging to all the above enumerated genera, *Phyllospadix* excepted, have been reported, most of them from the eastern coasts of the continent, a few only from the western side.

During my visit to West Australia in 1914 I succeeded in finding a couple of species new to the flora of that State, and in making observations as regards the distribution and biology of other species. An account of these observations forms the subject of the present paper, which also includes the earlier records of sea-grasses along the West Australian coast.

As early as in 1792 Labillardière found a sterile sea-grass on the West Australian coast near Cape Leeuwin and described it in 1806 under the name of *Ruppia antarctica*[1]. The same species was later collected by Gaudichaud in 1818 at Sharks Bay and this time male flowers were found and figured under the name of *Amphibolis zosterifolius* Agardh[2].

[1] Labillardière, Nov. Holland. Plant. species, vol. II, p. 116, tab. 264, 1806.

[2] Gaudichaud, Voyage autour du Monde, Botanique, p. 35 et p. 161, pl. 40, fig. 2. 1826.

Later on (1854) W. H. Harvey[1] during his investigations of the West Australian Marine Algæ met with sea-grasses, and in his reports on the algæ he mentions them incidentally. Thus when describing the algal vegetation of King George's Sound he states (1855, p. 527): "On the leaves of *Zostera* and on the stems of *Caulinia antarctica*, both of which form vast meadows in water from two to six feet deep, grows ...."; further he mentions the same two species when reporting on the Algæ off Rottnest Island and Fremantle (l. c. p. 528 and p. 529).

The two species are now known under the names *Cymodocea antarctica* Endl. (= *Ruppia a.* Labill, *Caulinia a.* R. Br.) and *Posidonia australis* Hook f. (Harvey's *Zostera*). It appears from these reports that they play an important rôle in the marine vegetation of the south-western coast of West-Australia from Albany in the south to Sharks Bay in the north.

Since the time of Harvey's visit little has been added to our knowledge of the sea-grasses of West Australia. A few interesting notes are found in a report on sea-grasses from the Indian Ocean published by P. Ascherson[2]. Dr. Naumann, the doctor of the German warship "Gazelle" then engaged in deep sea soundings etc. in the Indian Ocean, became interested in the study of sea-grasses, and from him P. Ascherson received several letters and specimens of sea-grasses. As regards West Australia Dr. Naumann says: "Die Gazelle besuchte Ende April [1875] Australien an zwei Orten, an der Westküste bei Cap Inscription, der Nordspitze von Dirk Hartog Island, und in Nordwesten, hier innerhalb des Dampier-Archipels beim Fastlande ankernd. An ersterem Orte wurde aus dem Ankergrunde (7 Faden tief) viel langhalmiges, zum Teil ziemlich frisch aussehendes Seegras mit dem Schleppnetz heraufgebracht [This species was not received by Ascherson, probably it was *Posidonia*]. Am Strande der Insel bemerkte ich, fast im Sande in der Brandung vergraben, einige Stückchen des beifolgenden kurzhalmigen Seegrases [*Cymodocea antarctica*], das jedenfalls dort, aber nur vereinzelt wuchs. Auch war hier ein wenig der vorhin genannten Art mit langen Halmen aufgespült. In der Nähe der Nordwestspitze Australiens, im N.W. der Montebello-Inseln brachte das Oberflächennetz abermals Seegras aus dem Meere, aber nur

[1] Harvey, W. H. Some Account of the Marine Botany of the Colony of Western Australia. Transact. R. Irish Acad. vol. XXII, Part V, 1855.

[2] P. Ascherson: Ueber Meeresphanerogamen des indischen Ozeans und indischen Archipels. Botanische Zeitung 1875, pp. 761—765.

wenige Stückchen [*Cymod. rotundata*, determ. Ascherson]; das nächste Land war hier 20 Seemeilen entfernt. Weiterhin zwischen den Dampier-Inseln trieben sehr grosse Massen verschiedener Sargassum-Arten, aber von Seegras keine Spur, auch nicht beim Fastlande".

In F. v. MÜLLER's and A. MORRISON's list[1] of the flora of W. A. we find only the two first recorded species, *Posidonia* and *Cym. antarctica* (the *Cymodocea* is given here under the name of *C. zosterifolia* F. M.), but not *Cym. rotundata*. Later P. ASCHERSON[2] added one more species to the flora, viz. *Cymodocea isoëtifolia* from Champion Bay (i. e. off Geraldton), thus making four species. A fifth has recently been discovered, viz. *Halophila ovalis*, which C. ANDREWS[3] in 1902 found in Freshwater Bay, Swan River Estuary, and still later it was collected at Rottnest Island, off Fremantle. We have thus recorded 5 species, if we regard the free-floating *C. rotundata* as growing on the West Australian coast. All these five[4] species were also found by me with the addition of two more, viz. *Halophila spinulosa* and *Diplanthera uninervis*, both of which are known from the tropical eastern coast of Australia. The sea-grass flora of West Australia now extends to 7 species, nearly one fourth of the whole sea-grass flora of the Earth.

As to their distribution along the extensive coast-line of W. A. our knowledge is very scanty. But it is remarkable that the north coast from N. W. Cape to King Sound seems to harbour no sea-grasses at all. Dr. NAUMANN emphazises that he did not see any sea-grasses in Dampier's Archipelago (his *Cym. rotundata* was floating on the surface, not growing), nor at any of the places where I landed (Point Samson, Port Hedland, Broome, Derby) did I find any trace of them. Now it is a well known fact that the north coast of W. A. has a very strongly marked tide, rising in places from 10 to 15 metres. This may be the reason for the absence of sea-grasses, since they cannot endure being laid bare and daily exposed to the burning tropical sun during low tide,

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1 F. v. MÜLLER: List of Extra-tropic West Australian Plants. Revised and augmented by A. MORRISON. Western Australian Yearbook for 1900—1901, vol. I. Perth 1902.

2 P. ASCHERSON: Die geographische Verbreitung der Seegräser, in: G. von Neumayer: Anleit. z. wiss. Beobacht. auf Reisen. 3. ed. 1905.

3 C. ANDREWS: Halophila ovalis Hook. f., an Addition to the Flora of West Australia. Journ. of Proc. Mueller Botan. Soc., Perth, vol. I, No. 10, 1902.

4 As regard the correctness of the identification of *Cym. rotundata* see p. 11.

while further out they would be covered at high tide by more water than is usually the case where they grow. Other unfavourable factors may be, that the water falls and rises with great force, and that its movements stir up the fine mud particles and greatly reduce the transparency of the water. Of course these are only suppositions, but the fact remains that sea-grasses do not seem to grow along the north coast, and also that Algæ are very scarce there.

Along the west coast the case is quite different. As Mrs. C. M. G. Dakin states (in the Handbook and Guide to W. A. 1914, p. 73), there is no strong tide here. "The average tide at Fremantle is only about one or two feet". Here we find a well-developed sea-grass vegetation in the more sheltered places, and in many cases it covers wide areas, as at Shark's Bay.

The following are notes from my diary on the occurrence of sea-grasses at different places of the west coast of W. A.

1. The coast of the Cave District off the Yallingup Cave (between Cape Naturaliste and Cape Leeuwin), Sept. 26th 1914. The coast is partly sandy, partly rocky. The rocks consist of a calcareous conglomerate of grains of sand bound together by lime. In this rock formation numerous pools and flats with shallow water are found; they are protected by the outer fringe of rocks from the enormous force of the ocean waves, and harbour a rich algal vegetation in which *Cystoseira* species and *Corallinaceæ* are dominant. The algæ grow fixed to the rocks bordering the pools, while the sandy bottoms are largely covered with *Cymodocea antarctica* and *Halophila ovalis.*

   At the Cottesloe beach near Fremantle the conditions were much the same, but *Halophila* was not seen there, only *Cymod. antarctica.*

2. Geraldton, Octob. 28th and 29th 1914. Many sea-grasses were thrown ashore and formed a low wall on the open sandy coast. I noticed a few specimens of *Halophila ovalis* and *Cymodocea antarctica*, some specimens of *Cym. isoëtifolia* and great masses of *Posidonia australis*, leaves and fruits.

   The sea bottom, seen from the jetty, is barren naked sand close to the shore, but outside this a dense covering is seen over wide areas, probably of *Posidonia.*

3. Sharks Bay at Carnarvon, Octob. 31st 1914. Sharks Bay is rather shallow, and in calm weather when steaming over the bay from Cape Inscription to Carnarvon the sea bottom was visible nearly the whole time. The bottom is plant-covered

with white naked patches between. So far as I could discover, the vegetation nearly always consists of sea-grasses, the detached leaves and shoots of which were common on the surface of the water near the jetty. Along the shore there was a fringe of washed-up material consisting almost entirely of sea-grasses, with very few pieces of algæ intermixed. The main bulk was leaves of *Posidonia*, of which some fruits and empty pericarps were seen; in addition there was abundance of *Cymodocea isoëtifolia*, *Cym. angustata* nov. sp., some *Cym. antarctica* and *Halophila spinulosa*, and a few pieces of *Halophila ovalis* and *Diplanthera uninervis.*

From this list of species of the shore fringe, it is probable that the sea-grass vegetation of the bottom consists mainly of *Posidonia* with the *Cymodoceæ*, *Halophilæ* and *Diplanthera* as subordinate elements.

Sharks Bay in particular must produce enormous quantities of sea-grasses, as such wide areas are suitable for their growth, and I was told that nearly the whole Bay had a green bottom.

Other places suitable for sea-grass vegetation are:

4. King George's Sound. During my short visit to Albany there was no time to investigate the sea-grass vegetation, but we have the earlier records by Harvey, who tells about the occurrence of large meadows of *Cymod. antarctica* and *Posidonia.*
5. Flinders Bay.
6. Geographe Bay.
7. Rottnest Island, where Harvey dredged and found sea-grasses.
8. The Abrolhos Island to the west of Geraldton (Champion Bay).

On the whole, all places where there is a little shelter will most probably be found to bear a sea-grass vegetation, while on the other hand the open and quite unprotected coast will be devoid of them, unless they find a refuge in shallow pools amongst rocks, as was the case on the coast off Yallingup (see above).

The depth to which the sea-grass vegetation of W. A. extends, is not known. We have only the records of 2 to 6 feet ($^2/_3$—2 m) by Harvey and of 7 fathoms (c. 13 m) by Naumann.

No doubt the limit lies somewhat deeper than the two records, and investigations on this point are highly desirable.

## Special Part.

# Fam. I. Potamogetonaceæ.

This family furnishes five West Australian species of sea-grasses, four of the tribe *Cymodoceeæ* and one of the tribe *Posidonieæ*.

The *Cymodoceeæ* are the following:

*Cymodocea angustata* n. sp. (subg. *Phycagrostis*)
— *isoëtifolia* Aschers. (subg. *Phycoschoenus*)
— *antarctica* (Labill.) Endl. (subg. *Amphibolis*).
*Diplanthera uninervis* (Forsk.) Aschers.

The tribe *Posidonieæ* has only one genus *Posidonia*, with two species, one of which is Australian, viz.:

*Posidonia australis* J. D. Hook.

The three species of *Cymodocea* and *Posidonia australis* are here dealt with at some length, while the *Diplanthera* material does not show any essential point of interest.

### 1. **Cymodocea angustata** nov. sp.

*Subgen. Phycagrostis. Rhizoma repens, foliorum cicatricibus annulos apertos efformantibus. Vaginæ foliorum longe obconicæ, valde compressæ, 2—8 cm longæ, 4—5 (3—7) mm longæ, diametro pluries longiores, distincte biauriculatæ, pallide purpurascentes (in sicco). Foliorum laminæ lineales, 9—13-nerviæ, 10—20, rarius usque ad 60 cm. longæ, 4—5 (3—6) mm latæ, superne sensim angustatæ et distincte serrulatæ, apice obtuso. Flos masculus ignotus. Flos femineus præter stigmatum apices inclusus; carpella bina ovoidea; stylus curtus teres; stigmata bina, longissima, filiformia. Fructus (immaturus) compressus, suborbicularis vel ovali-orbicularis, marginibus integerrimis.*

*Differt a C. rotundata et C. nodosa præcipue foliis latioribus distincte serrulatis; a C. serrulata præcipue foliis angustioribus, longioribus et vaginis longis, pallide purpurascentibus; ab omnibus præcipue foliis superne angustatis.*

*Hab. in mare ad Carnarvon Australiæ occidentalis.*

At Carnarvon I found quite a number of specimens of a *Cymodocea* cast ashore, and from the freshness of the leaves and rhizomes it must be regarded as certain that the plant was growing at a short distance from the beach. The specimens collected (C. H. Ostenfeld, Plantae ex Austr. occid. No. 271) consisted of the younger parts of the rhizomes with leaves, roots and, in some specimens, the female reproductive organs.

At first I identified it as *C. rotundata* Aschers. et Schweinf., which, as quoted above, was found floating near the Montebello Islands by Dr. Naumann in 1875. But on closer examination it soon became evident that it differed considerably from this species and did not agree with any hitherto described species. Therefore I describe it as new, the fourth species of the subgenus *Phycagrostis*.

Fig. 1. *Cymodocea angustata* n. sp. To the left a specimen with an unripe fruit, to the right another with a female flower enclosed in the sheath. (2/3 nat. size.)

As no later record of *C. rotundata* from the coast of West Australia is available, I consider its occurrence as doubtful and am inclined to think that Dr. Naumann's specimens also belonged to my new species, not to *C. rotundata*.

*C. angustata* is related to *C. rotundata*, *C. nodosa*, and *C. serrulata*, as will be seen from the diagnosis and from the following description of the specimens collected (both herbarium and alcohol material):

The creeping rhizome has elongated internodes; at each node

one leaf and one root appear. The rhizome branches freely, especially where flowers are found, and here, sometimes elsewhere, parts of the rhizomes have short internodes (in *C. nodosa*, which is best known, each zone of short internodes is said to correspond to the wintertime). The flower is solitary and terminal; it is inclosed in a leaf similar to the others, while a bud in the axil of the uppermost leaf but one develops into the prolongation of the main axis; thus the growth of the flowering rhizome becomes sympodial, whereas the infertile rhizome is a monopodium. Each lateral shoot begins with a blade-less sheathing leaf, placed with its dorsal side against the main axis. The ordinary leaves have an open (split) compressed sheath which incloses the basal parts of the younger leaves, or the flower. At the apex the sheath is somewhat biauriculate; it varies in width from 3 to 7 mm and is wider in the upper part, narrower towards the base. The

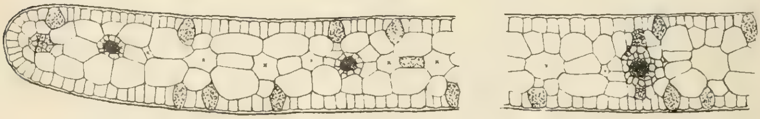

Fig. 2. *Cymodocea angustata.*
Transverse section of a leaf-blade. To the left the marginal part with a marginal sclerenchyma-strand and two side-veins; to the right the central part with the mid-vein. Tannin idioblasts dotted; x lacunæ. (About $^{125}/_{1}$ nat. size.)

leaf blade is shorter and broader than in *C. rotundata* and *C. nodosa*, longer and narrower than in *C. serrulata*, the proportions being 15—20 cm (in a single shoot 60 cm) long and 3—6 (mostly 4—5) mm broad. In its upper part the width of the blade decreases regularly towards the obtuse tip, the margins being distinctly serrulate, especially at the apex. 9—13 parallel nerves run through the blade, besides two marginal sclerenchyma-strands (Fig. 3 *a*). The surface of the whole leaf is very finely spotted by cells of a red-brown colour containing some tannic compound ("cellules sécrétrices", Sauvageau).

The place where the blade and sheath meet is distinctly marked and the blade breaks off easily, leaving the sheath persistent for some time.

As to the anatomy of the leaves, there is great resemblance between *C. nodosa*, *C. rotundata* and *C. serrulata* as shown by P. Magnus[1] and C. Sauvageau[1]; *C. angustata* does not differ in any essential

[1] P. Magnus, in Sitz. ber. d. Ges. naturf. Freunde, Berlin f. 1870, p. 85.

point. Nevertheless, in several minor points a transverse section of a leaf-blade of *C. angustata* is characteristic and makes it possible to distinguish this species from the three others. Fig. 2 shows that the lacunae (air chambers) of the leaves (marked ×) are small and narrow, much smaller than in the other species; this is correlated with the lesser thickness of the leaf and the fewer layers of cells inside the epidermis. The tannin (?) idioblasts (dotted in the fig.) of the epidermal layer are numerous, and cells of the same kind occur sometimes in the interior of the leaf. The veins do not show any difference from those of the other species, but it is noteworthy that the sclerenchyma is very poorly developed: just inside the leaf-margins a small sclerenchyma-strand is found, and on both sides of the central vein small subepidermal sclerenchyma-strands are present, while such strands are absent beside the other veins. A comparison of my figures with those of Sauvageau will make the differences clear better than a long explanation.

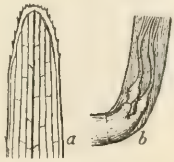

Fig. 3. *Cymodocea angustata.* *a* Apex of a leaf. *b* Female flower ($^4/_3$ nat. size).

I have not succeeded in finding the male flowers; but judging from the near relationship to the other species it is probable that the male flowers are much alike. Thus we should expect the male flower of *C. angustata* to be a terminal one, consisting of a long filament and an 8-locular anther, i. e. really two connate stamens.

The female flower consists of two free short-stalked carpels, each surmounted by a short style and two very long thread-like stigmas (Fig. 3 *b*). The upper parts of the stigmas protrude out of the leaf-sheath while the rest of the flower is inclosed by it. As seen in fig. 1 the long stigmas have sometimes difficulty in finding their way out of the sheath and become much bent or coiled. After fertilisation the carpels begin to grow out and the upper part of the stigma dies away. In one specimen I found one carpel half-grown and the other broken off (Fig. 1). The young fruit was compressed and nearly round in circumference, with a curved beak, not oblique as in the fruits of *C. nodosa* and *C. rotundata.* In another specimen (that with the flower) a pair of fruit-stalks were present while the fruits themselves had disappeared. The fruits have a thin fleshy layer outside the hard endocarp. I have not seen the ripe fruits.

[1] C. Sauvageau, Observations sur la structure des feuilles aquatiques. — Journ. de Botanique, t. IV (1890).

Idem: Sur les feuilles de quelques monocotylédones aquatiques. — Ann. sc. nat. VII sér. Bot. t. 13 (1891), 103—296.

The new species has a somewhat intermediate position between *C. nodosa* and *C. rotundata* on one side, and *C. serrulata* on the other. It differs from *C. nodosa* and *C. rotundata* in the well-developed marginal teeth, the broader leaves and the open rings (scars) on the stem, left by the leaf-sheaths; besides the shape of the drupelet is different. From *C. serrulata*, on the other hand, it differs in the longer and narrower leaves and leaf-sheaths, the lighter (pale purplish) colour of the sheaths, and the smaller number (9—13) of nerves. The main difference from both lies in the regularly tapering uppermost part of the blade and the shape of the drupelet.

It has in common with *C. nodosa* and *C. rotundata* the light purplish colour of the sheaths, the number of nerves and the slightly obconical shape of the sheaths; in common with *C. serrulata* the well-developed marginal teeth and the open rings on the stem left by the sheaths; these scars are closed (annular) in *C. nodosa* and *C. rotundata*, which means that the sheath wholly encloses the axis, while in *C. serrulata* and *C. angustata* a small part of the circumference is free from the sheath.

In morphology it does not differ in any important feature from what we know about the morphology of *C. nodosa*, which is well known through the investigations of E. Bornet[1], Ch. Flahault[2] and others.

As to the geographical distribution, the new species is only known from Carnarvon, but I think it probable that Dr. Naumann's plant was also *C. angustata*, and not *C. rotundata*.

I have seen *C. rotundata* from the Red Sea, Madagascar, Andamans and Nicobar Islands, Java, the Philippines and Queensland (Port Denison, leg. Fitzalan, in the National Herb. of Victoria) and P. Ascherson (Geogr. Verbreit. Seegräser (1905) 398) gives further: Timor, Anachorete Isls., New-Hannover and New-Mecklenburg. Perhaps some of the Melanesian records should be placed under the new species. The same uncertainty rules with regard to *C. serrulata*, specimens of which I have seen from the Red Sea, the East coast area of Africa, Ceylon Strait, the Philippines, New Guinea and from Queensland, and Ascherson (l. c.) has the further records: Singapore and New Caledonia. It will be necessary to re-examine each of these records in comparison with *C. angustata*.

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[1] E. Bornet, Recherches sur le Phucagrostis major Cavol. — Ann. sc. nat. Botanique, V ser., t. 1, 1864.

[2] Ch. Flahault, Cymodocea, in Kirchner, Loew u. Schroeter: Lebensgeschichte der Blütenpflanzen Mitteleuropas, Bd. 1, Abt. 1 (1908) 529.

**2. Cymodocea isoëtifolia** Ascherson,

in Sitzber. Ges. Naturforsch. Freunde Berlin (1867) 3; in Das Pflanzenreich IV 11 (1907) 149; Bentham, Fl. Austr. VII (1878) 178; F. v. Müller, Sec. Census Austr. Pl. (1889) 204.

Both male and female plants were cast ashore at Carnarvon (No. 262); they had a dark green colour. Sterile shoots were found at the beach of Geraldton (No. 263). But in none of the collections were creeping rhizomes present.

The species has been reported once before from West Australia (Champion Bay) by P. Ascherson (see e. g. his paper of 1905), but this record is not quoted by Bentham, nor by F. v. Müller. In the herbarium of Lund, Sweden, and in the National Herbarium of Victoria I have seen specimens labelled "Champion Bay, West Australia, comm. F. v. Müller" and dated "$^{26}/_{7}$ 1879, Ascherson". But I am unable to state the name of the collector or to give any further communication throwing light upon this record, the correctness of which has been doubted. Nevertheless my discovery of the plant both at Geraldton (= Champion Bay) and at Carnarvon corroborates it.

As to the other parts of Australia, Bentham (l. c.) reports it as doubtful from Edgecombe Bay, Queensland (Fitzalan), and I have seen specimens from this locality in the Herbarium of Kew; they belong really to our species. I may add that fragmentary leaves of a sea-grass from Port Denison, Queensland (Fitzalan) in the National Herbarium of Victoria also belong to *C. isoëtifolia* for which we now have certain records from both the west and the east sides of tropical Australia.

The general distribution of the species extends from the Red Sea eastwards to Oceania. The West Australian localities are the most southerly and the only ones which lie south of the tropic of Capricorn.

*C. isoëtifolia* and its near relative *C. manatorum* Aschers. (Sitzber. Ges. Naturf. Freunde Berlin (1868) 19) form the well-defined subgenus *Phycoschoenus* Aschers. characterized by a cymose inflorescense and the terete and filiform leaf-blades. The two species are very closely allied. Ascherson (1868, p. 19) gives the following distinctive features for *C. manatorum*: "schon steril durch längere und dünnere, trocken kaum 1 mm breite, beim Trockenen schwarz werdende Blätter zu unterscheiden, während sie bei der *C. isoëtifolia* eine helle, graugrüne Farbe beibehalten. Die bisher allein vorliegenden weiblichen Blüthen und Früchte weichen von denen der *C. isoëtifolia* durch viel beträchtlichere Grösse ab (letztere

8 mm lang, bei jenen nur 3), letztere zeigen auch eine gestrecktere Form, indem sie als halbelliptisch (jene halboval) zu bezeichnen sind". Later, the male flower has been found as may be seen from ASCHERSON (1907) in „Das Pflanzenreich" (IV, 11; 149) where the anthers of *C. isoëtifolia* are given as 2 mm long. Here the diagnosis of *C. manatorum* consists only of the following words: "A praecedente ɔ: [*C. isoëtifolia*] differt: Folia longiora graciliora in sicco nigricantia. Flores quam in praecedente plus duplo majores, sed iis *C. nodosae* minores".

The flowering material of *C. isoëtifolia* from Carnarvon gave an opportunity for a more detailed study of the differences between the two species, as I had also ample material of *C. manatorum* from the Danish West-Indies, collected by E. WARMING and myself.

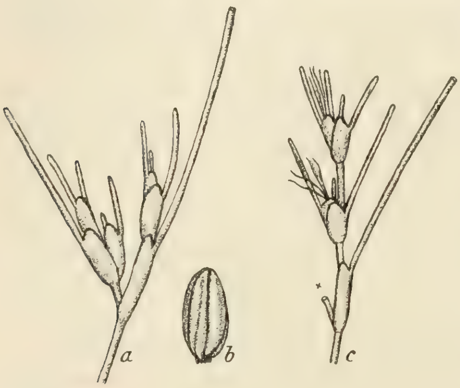

Fig. 4. *Cymodocea isoëtifolia* from Carnarvon. *a* A male inflorescence. *b* A male flower. *c* Part of a female inflorescence. (*a* and *c*, nat. size; *b*, 3 : 1 nat. size.)

As to the length of the leaves of *C. isoëtifolia*, the Geraldton specimens show that it varies from 20—30 cm (including the sheaths which are 3—4 cm); in the Carnarvon specimens the leaves are 12—15 cm long with sheaths 2—2,5 cm long. Specimens in the Botanical Museum of Copenhagen from the Red Sea and from Ceylon have the leaves nearly as long as those from Geraldton, while, according to ASCHERSON (1907) the leaves reach only 15 cm, i. e. only the half of what I have actually measured. The leaves of numerous specimens of *C. manatorum* from the West Indies attain to 32 cm at the most, with sheaths 4—4,5 cm long. Therefore, as regards length of leaves there is no difference between the two species; the same is the case with their colour.

SAUVAGEAU (1890, pp. 188—191) has studied the anatomy of the leaves of the two species. On the whole they are much alike, but there is a well-marked difference in the number of veins. In *C. manatorum* there are only two "lateral" veins besides the central one, while in *C. isoëtifolia* the "lateral" veins, which are

arranged in a circle around the air-channels and the central vein, vary in number from 7 to 15. This difference between the species I have been able to verify by examining several specimens of both species, with this exception that the number of "lateral" veins

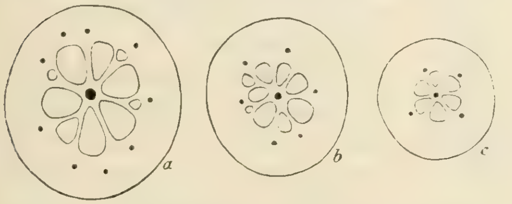


Fig. 5. *Cym. isoëtifolia.* Transverse sections of leaf-blades. *a*, of foliage leaf, from Ceylon; *b*, of foliage leaf from Carnarvon; *c*, of inflorescence leaf from Carnarvon. The black points represent the veins, the circles the lacunæ. (About $^{20}/_{1}$ nat. size.)

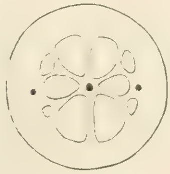

Fig. 6. *Cym. manatorum* Aschers., from St. Croix, Danish W. Indies. Transverse section of leaf-blade. (About $^{20}/_{1}$ nat. size.)

in *C. isoëtifolia* sometimes may be reduced to 4. The specimens from Carnarvon had 6—7 lateral veins in the foliage leaves, but only 4 in the short leaf-blades of the inflorescences, and specimens from Ceylon had 9—10 "lateral" veins (see Fig. 5). On the other hand in all the leaves of *C. manatorum* from the West Indies examined by me the number of lateral veins was only two (Fig. 6), as stated by Sauvageau. We have thus in this character a distinctive mark of value, which is the more desirable because the other characters taken from the leaves do not stand on closer examination.

The inflorescence of the two species of the subgenus *Phycoschoenus* is very characteristic[1], and is the same in both species. The diagrammatic figures (Fig. 7) of young male and female inflorescences from Carnarvon show their cymose character better than drawings of the inflorescences themselves (Fig. 4). The cyme begins two-sided, but the younger parts are one-sided. The prim-

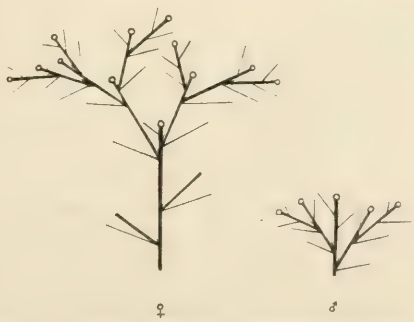


Fig. 7. *Cym. isoëtifolia*, from Carnarvon. Diagrams of female and male inflorescences, with flowers, leafy-bracts and prophylla.

[1] P. Magnus has described the inflorescence of *C. manatorum* in Sitzber. Naturforsch. Freunde, Berlin, 19. März 1872.

ary axis usually has one or two leafy bracts inserted above those leafy bracts from the axils of which the secondary axes arise; this arrangement occurs again in the youngest one-sided parts of the inflorescence, whereas in its median part each axis has only the two leafy bracts subtending branches.

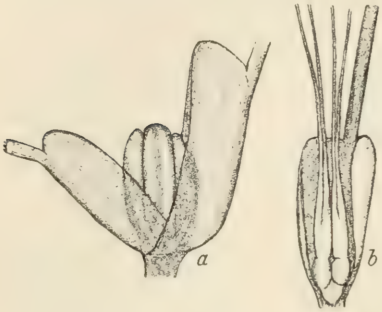


Fig. 8. *Cymodocea isoëtifolia.* *a*, Male flower; *b*, Female flower. ($^4/_1$ nat. size.)

The flowers are covered by the inflated sheaths of the leafy bracts. In the female flower the four stigmatic branches are seen above the sheaths. In the male flower the anther must be supposed to appear when it is ripe, but I have not succeeded in finding this stage. All the male flowers examined by me had a sessile double stamen inclosed in the sheath or sheaths (Fig. 8 *a*); the filament is so short that the anther is almost sessile, but most probably it elongates suddenly thus enabling the anther to extend beyond the sheath, or perhaps the whole anther breaks off when ripe.

The structure of the male flower is the same as in other species of *Cymodocea*, and there seems to be no difference between the two species. In both the flower consists only of two connate stamens. The anthers are extrorse and the whole flower looks like one 8-locular stamen. A transverse section through the middle shows four bilocular parts, and it is only in the upper half that the two anthers become distinct from each other (Fig. 9). In *C. isoëtifolia* the anther is 3.5—4.2 mm long and 1.7—2.0 mm thick, and the pollen sacs are often somewhat twisted (see Fig. 4 *b*). In the two male flowers of *C. manatorum* which I have been able to examine, the anthers were a little shorter and broader: 3.1 and 3.6 mm

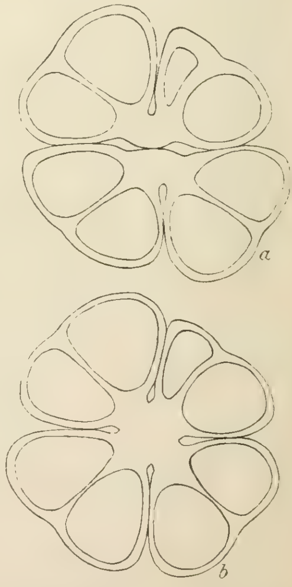


Fig. 9. *Cym. isoëtifolia.* Transverse sections of the male flower. *a*, above the middle; *b*, through the middle. (About $^{20}/_1$ nat. size.)

long and 2.0—2.2 mm thick, and the pollen sacs were not at all twisted. There is thus a slight difference in shape between the male flowers of the two species, but nothing to justify the statement by ASCHERSON that the flowers of *C. manatorum* are twice as large as those of *C. isoëtifolia*[1].

As regards the female flowers I have not found any discernible difference between the two species. They have the same size and the same shape (see Fig. 8 *b* of *C. isoëtifolia*). On the other hand there seems to be a distinctive character in the size of the fruits as already given by ASCHERSON (1868). I have measured ripe fruits of *C. manatorum* from Cuba which were 6 mm long (the beak not included), and unripe (?) fruits of *C. isoëtifolia* from India (the Australian specimens were in flower only) were 3.5 mm long; also their shape is somewhat different, viz.: oblique-obovate in *C. manatorum* and oblique-elliptic in *C. isoëtifolia*.

Summarising, we must admit: (1) that the Indo-pacific *C. isoëtifolia* and the Caribbean *C. manatorum* are very near in character; (2) that most of the distinctive marks hitherto given do not hold good; (3) that small differences in the anatomy of the leaves and in the size and shape of the anthers and fruits make it possible to retain them as distinct species.

### 3. **Cymodocea antarctica** (Labill.) Endl.,

Genera plant. (1836) 230; Ascherson, in Das Pflanzenreich IV, 11 (1907) 151; *C. zosterifolia* F. v. Müller, Census of Austr. Plants (1882) 121; *Ruppia antarct.* Labillardière, l. c. (1806) 116, tab. 264; *Caulinia antarct.* R. Br., Prodr. Nov. Holl. (1810) 339; *Amphibolis bicornis* C. A. Agardh, Spec. Algar. I, 2 (1822) 474; *A. zosteræfolia* C. A. Agardh, l. c. 475; Gaudichaud, l. c. (1826) 35 et 161, pl. 40, fig. 2; *A. antarct.* Sonder et Ascherson, Linnæa 35 (1867) 164; *Pectinella àntàrct.* I. M. Black, Transact. Roy. Soc. South Australia, XXXVII (1913) 1, pl. I et ibid. XXXIX (1915) 94; *P. Griffithii* I. M. Black, l. c. (1915) 94.

As already stated in the present paper (p. 6), this characteristic species is common along the southern part of the West Australian coast. I saw it in the Cave district (No. 267), at Cottesloe beach, at Geraldton (No. 264), and at Carnarvon, Sharks Bay (No. 265). LABILLARDIÈRE (l. c.) reports it from Cape Leeuwin, HARVEY (l. c.) from King George's Sound, Rottnest Island and Fremantle, GAUDICHAUD (l. c.) and NAUMANN (see ASCHERSON

[1] He says (Sitzber. Naturf. Freunde, 20. Oct. 1868) that *C. manatorum* "besitzt lineale, fast 0.01 m lange Antheren, welche sich von den ovalen kaum 0,003 m langen der *C. isoëtifolia* noch auffaldender unterscheiden als dies bei den weiblichen Blüten der Fall war".

(1875) 762) from Sharks Bay; in the herbaria at Kew and the British Museum I have seen specimens from King George's Sound and from Swan River, and in the U. S. National Herbarium specimens from Champion Bay, and I have got specimens from Bunburry, collected by Mr. Chas. G. Hamilton (No. 266). The distribution of these localities enables us to regard the species as growing all along the coast from Sharks Bay in the north to King George's Sound in the south.

Outside West Australia it is known from South Australia and Victoria; it is also said to occur at Tasmania (see e. g. Ascherson 1907), but I have not seen any specimens from there, neither does I. M. Black (1913) mention it from this State. The general distribution is, consequently, rather restricted, embracing only the southern and the temperate western coasts of Australia.

The species stands rather isolated within the genus. The synonyms cited above show how difficult it has been to find the right place for it, and still my citations are far from complete; it has further been referred to several other genera (*Kernera* Willd., *Graumuellera* Rchb., *Thalassia* Soland). Quite recently I. M. Black (1913) has founded the new genus *Pectinella*[1] on it. It might be quite reasonable to segregate it as a genus, as it has many characters of its own, but I prefer to keep it in the genus *Cymodocea*, because its flowers, both female and male, do not in essential points differ from those of the other species of *Cymodocea*.

Ascherson (Sitzber. Naturforsch. Freunde Berlin (1870) 84) has shown that with regard to the vegetative parts of the plant our species has much in common with *C. ciliata* (Forsk.) Ehrb.[2], and he has adopted Agardh's genus name *Amphibolis* as a subgenus name for these two species. They are characterized by their hard lignose rhizomes with branched and elongated upright shoots; their anatomy has also much in common, as shown by P. Magnus (Sitzber. Naturf. Freunde Berlin (1870) 89). Nevertheless these two species are much more distant from

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[1] If it should be taken as a separate genus, Agardh's old name, *Amphibolis*, ought to be used, instead of creating a new name.

[2] This species is distributed from the Red Sea along the eastern coast of Africa as far south as Luabo and Mauritius. It is further found on the shores of Queensland (e. g. Port Denison, leg. Fitzalan). In the National herbarium of Victoria (Melbourne) I have seen a specimen labelled "W. Australia, Geographe Bay, Herb. W. Sonder, Hamburg", but no doubt there is some mistake here.

each other than is the case with the species within the other subgenera of *Cymodocea.*

*C. antarctica* has some very striking features in its growth


Fig. 10. *Cymodocea antarctica*, from Yallingup Cave District. To the left a "seedling", in the middle a much branched assimilative shoot, to the right the younger part of a rhizome with its assimilative shoots. (Photo. of herbarium material.)

and biology, and these features have been interpreted in very different ways by different authors. Therefore I think it appropriate to give a description of the structure and biology so far

as they are known, besides a summarising review of the scattered papers in which the species is dealt with.

In contrast to the other *Cymodoceæ* (perhaps *C. ciliata* excepted) the creeping rhizome of *C. antarctica* is a sympodium, much like the rhizomes of *Potamogeton* species. Each shoot which takes part in the rhizome formation, begins as a horizontally creeping rhizome with several internodes; the leaves of the rhizome are bracts consisting of a clasping sheath and a diminutive blade, and dorsally just beneath the leaf-scars, two roots appear (Fig. 11) which fasten the rhizome into the soil where it is rather deeply imbedded. After the development of a number of horizontal internodes the shoot elevates itself, generally by somewhat longer internodes, and it becomes upright, ceasing to send off roots from the nodes; at the same time a regular transition from nearly bladeless bracts to blade-bearing leaves is seen to take place. The upright assimilative shoot may become very long (up to 1 m); it branches freely, producing short leaf-bearing lateral shoots (see Fig. 10; also well figured by LABILLARDIÈRE) and at the right season the flowers are to be found terminally at the apex of these shoots.

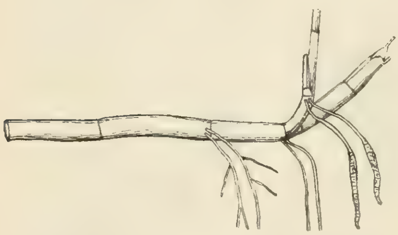

Fig. 11. *Cym. antarctica*, from Yallingup Cave District. Part of the creeping rhizome, with roots, the base of an erect shoot and the principal bud. ($^3/_4$ nat. size.)

In the axil of a leaf at the transition zone from creeping to upright, the principal bud which continues the rhizome formation is found (see Figs. 11 and 12). It begins with a very short internode showing the scar of the prophyllum, and then follow several elongated internodes of which the two first do not usually form roots. Very often the axil of the next leaf of the shoot also produces a bud which develops into another horizontal rhizome (see Fig. 12 to the left); it is not so strong as that from the lower axil, and sometimes it is checked in its growth remaining short and poorly developed (see Fig. 11). The scale-leaves of the rhizomes and the leaves of the lower parts of the upright shoots fall off very quickly leaving annular scars. At the top of each branch of an upright shoot there is a tuft of distichous leaves. The whole upright shoot is evidently of rather short duration, and it breaks off near the ground. According to TEPPER, quoted

by ASCHERSON (1882, 30)[1], the shoots break off in September and October, and are thrown up on the shore by the waves. When I collected *C. antarctica* in the pools on the coast of Yallingup on Septh. 26th, I did not get the impression that the season for their shedding had begun, but perhaps the time is not quite fixed. When examining the material I discovered remains of the short basal parts of the stems of the assimilative shoots shed last season; their dark, nearly black colour distinguished them clearly from the light-coloured stems of the present year-shoots. The rhizomes are very richly branched and, undoubtedly, they last for a longer time; they were rooted by many divaricate much-branched roots. (see Fig. 10). When ASCHERSON (1882) states that, according to TEPPER, the rhizomes do not propagate the plant from year to year ("Da ihre im Boden liegenden Teile, soweit Tepper beobachtete, niemals Knospen bilden, so würde die Pflanze nicht auf anderem als auf sexuellem Wege sich fortpflanzen können, wenn nicht" etc.), this observation is wrong. Evidently the rhizome sends up new upright shoots each growing season, just as the perennial rhizome-bearing pondweeds do.

Fig. 12. *Cym. antarctica*, from Carnarvon. An old seedling grown from the "comb" and with creeping rhizome and erect assimilative shoots. (About $^1/_2$ nat. size.)

[1] P. ASCHERSON: Die vegetative Vermehrung einer australischen Seegrasart, der Cymodocea antarctica (Labill.) Endl. — Sitzber. Botan. Vereins Prov. Brandenburg XXIV (1882) 28—33.

The leaves of *C. antarctica* are short compared with those of the other *Cymodoceæ* etc. There seems to be a correlation between this fact and the elongated upright axes. The short leaves stream freely in the water owing to the long stems, while in the other species the axes are short and the leaves long. The leaf-sheaths are compressed and conical. They fall off together with the blades when the plant sheds its leaves, whereas in most sea-grasses the blade alone is shed and the sheath persists on the stem for a longer time. The short blade is flat and ribbon-like, its margin is quite entire. At the apex two marginal teeth are found and the apex itself is often emarginate (semilunate), but this character is rather variable, and in the lower leaves there is little or no emargination and the teeth are absent, the apex is truncate or even obtuse. This variation has misled C. A. Agardh (l. c.) into making two species of his "*Amphibolis*", viz.: *A. bicornis*, i. e. the upper part of an assimilative shoot with its emarginate leaf-apex, and *A. zosteræfolia*, a young plant with truncate leaves.

Quite recently I. M. Black (l. c., 1915) has divided the species into two, and one of the distinctive characters is the length of the leaves. No doubt the length and breadth of the leaves differ much in different specimens, but it seems to me to be better explained by supposing that the depth at which the specimens grow and the fertility of the soil have some influence in this respect. In our Danish waters I have shown that such is the case with regard to the variations of length and breadth of *Zostera* leaves [1]. Black's new species *Pectinella Griffithii* is said to differ from his *Pectinella antarctica* by its 5.5—9.0 cm long leaves (those of *P. antarctica* being only 2.0—4.5 cm), and by certain features of the female flower, but until more decisive distinctions are found I think it better to regard these differences as of individual, not of specific value.

I have made measurements of the leaves of specimens from different localities, also of specimens kindly sent me by Mr. Black and representing both his species. In comparing these it is necessary to keep the leaves of the branches of the upright assimilative shoot apart from those of the main shoot itself, as the latter are generally longer and sometimes narrower.

The table given here shows a variation range from 2.0 to 7.0 cm. in length, and from 3.0 to 10.0 mm in breadth, but it

[1] C. H. Ostenfeld: On the ecology and distribution of the Grass-wrack (Zostera marina) in Danish waters. — Report of the Danish Biological Station XVI, 1908.

does not give any confirmation to the view of the existence of two different species:

Leaves of the branches of the upright shoot.

| | long (cm) | broad (mm) |
|---|---|---|
| Yallingup, W. A......... | 2.0—2.5 | 5.0— 8.5 |
| Port Philip Head, Vict. . | 2.5—4.5 | 6.0—10.0 |
| Henley Beach, S. A. .... | 2.2—3.5 | 3.0— 4.5 |
| — — — .... | 2.0—2.5 | 3.0— 4.0 |
| — — — .... | 3.0—3.5 | 3.5— 4.0 |
| — — — . .. | 4.0—5.5 | 3.0— 3.5 |
| Victor Harbour, S. A.... | 2.0—2.5 | 4.0— 5.0 |
| — — — ... | 3.0—4.0 | 3.5— 4.5 |
| — — — ... | 5.0—7.0 | 3.0— 4.0 |

Leaves of the young upright shoot itself (* of young plants, "seedlings".)

| | | |
|---|---|---|
| Carnarvon, W. A. ...... | 3.0—4.5 | 3.0—5.5 |
| Port Pirie, S. A......... | 3.0—3.3 | 3.0—3.5 |
| *Yallingup, W. A........ | 3.0—4.5 | 5.0—7.0 |
| *Carnarvon, W. A. ...... | 4.5—6.0 | 6.0—7.0 |
| *Bunburry, W. A. ... ... | 2.8—4.5 | 4.5—7.0 |
| *Henley Beach, S. A..... | 3.0—4.5 | 3.5—4.0 |

Passing now to the flowers of *C. antarctica.* Both the male and female flowers are terminal at the apex of the short branches of the upright shoots. The male flower was found and figured by GAUDICHAUD who says (1826, 35): "J'ai trouvé quatre étamines biloculaires connées et supportées par un petit pédicule (voyez pl. 40, fig 2)". In reality the flower is like the male flower of the other species of *Cymodocea*, i. e. it consists of two short-stalked 4-locular stamens connected on the dorsal side, and GAUDICHAUD's figure is also better explained in this manner than by regarding the flower as consisting of four stamens. I. M. BLACK (1913, Figs. 10—12) has given good drawings of them. The apices of the anthers are adorned by branched appendages. GAUDICHAUD has drawn the appendages as unbranched, and if Mr. BLACK's claim for the existence of two separate species is right, it would be worth while to look here for a distinctive feature.

A transverse section of the double stamen does not differ in any point worth mentioning from the section of the male flower of *C. isoëtifolia* (see Fig. 13). I have not had specimens preserved in fluid for examination, but have soaked herbarium specimens sent by Mr. BLACK and then hardened them in spirit. The length

of the anthers is about 5—6 mm (the appendages excepted). The whole male flower is sheltered by the sheath of the uppermost leaf, and it seems as if it never extends itself out of the sheath, but opens while surrounded by the sheath. At least none of the flowers examined by me show any elongation of the filament, nor does Mr. BLACK mention anything of that kind.

The female flower was first described by ASCHERSON in 1876[1] from a flower received from F. v. MÜLLER. I quote the description, as the journal in which it was published is difficult to get:

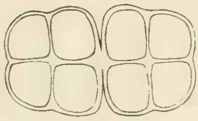

Fig. 13. *Cym. antarctica*, from Henley Beach, S. A. Transverse section of the male flower (about $^{10}/_{1}$ nat. size).

"Baron F. v. Müller sandte freundlichst ein Exemplar, von Mrs. Beal in Loutitt Bay westlich von Melbourne gesammelt, an dem er einen weiblichen Blütenstand bemerkt hatte. Unser berühmter Landsmann hatte bereits gesehen, dass sie, dem Charakter von *Cymodocea* entsprechend, aus zwei neben einander stehenden Carpellen bestehe, deren Griffellamelle sich, wie an diesem Exemplar zu erkennen, nahe über der Basis in zwei Aeste theilt. Die Blüthe bildet, wie bei *C. ciliata* und den Arten der Section *Phycagrostis*, den terminalen Abschluss eines Laubzweiges, dessen aüssere (an dem vorliegenden Exemplar beschädigte) Blätter von den gewöhnlichen Laubblättern nicht abzuweichen scheinen".

This description is correct in the main points, but not exhaustive. The next time we hear about the female reproductive organs, a very interesting discovery was made. At the request of F. v. MÜLLER and ASCHERSON, Mr. I. G. O. TEPPER studied the plant at Ardrossan (York Peninsula, South Australia) and published some papers on it in the Royal Soc. of South Australia[2].

According to BLACK (1913), it seems as if TEPPER had not found the young female flower, but only what he considered to be the female propagative organ. From his observations he draws the conclusion "that the plant does not at all develop a fruit proper, nor does the seed ever become dissociated from its plant, but that the fertilized ovum at once germinates and develops

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[1] In Sitzber. Ges. Naturforsch. Freunde Berlin (1876) 11.

[2] I. G. O. TEPPER: Some Observations on the Propagation o Cymodocea antarctica Endl. — Trans. Roy. Soc. South Australia, IV (1881) 1—4 and 47—49, pl. 1 and 5; and ibid. V, 37. — I have not access to the papers themselves, and am restricted to the abstracts given by P. ASCHERSON (1882) and I. M. BLACK (l. c., 1913).

into a new plant, which at maturity is detached and begins an independent cycle of existence".

This peculiar behaviour was doubted by Ascherson, who in his paper of 1882 gave a quite different explanation of the matter. Nevertheless, as very convincingly shown by I. M, Black, Mr. Tepper was right, and I may at once add that I can confirm Mr. Black's statements. We have in the propagation of *Cym. antarctica* a very interesting and unique kind of vivipary.

When C. A. Agardh (1822) described his *Amphibolis zosteræfolia* he mentioned that at the base of the plant there were peculiar comb-shaped horny bracts ("Basis e tribus vel quatuor squamis pectinatis cuneatis, erectis, semiunguem altis, osseis, albis constituta"). They formed a kind of cup from the inner part of which the stem arose. The nature of this "comb-cup" remained unexplained for a long time. Tepper evidently considered it as belonging to the female flower, as it makes up the basal part of what he took to be the "new plant". But Ascherson (1882, l. c.) rejects this explanation completely. He gives a detailed description of the comb and its relation to the stem and the ordinary leaves. The comb consist of 4 lobes, 2 broader and 2 narrower, which he regards as leaves transformed into peculiar scales adapted to the vegetative propagation of the plant. This propagation takes place in the following way (as observed by Tepper): The shoot breaks off beneath the comb and floats in the water until the comb acting as an anchor happens to hook on to some body on the sea-bottom, thus fastening the shoot which then takes root and grows into a new plant.

Ascherson's explanation of the vegetative nature of the comb was adopted universally, the more so as his description of the young female flower quoted above did not show any point which justifies a connection between the flower and the comb-shoot. It was not until I. M. Black found a series of successive stages of the development of the comb, that it became evident that Ascherson was quite wrong and that Tepper's observation and conclusion — incomplete as they are — were right. The comb-lobes are in reality outgrowths on the outer side of the pericarp, and the shoot which arises from the comb is a seedling from an embryo which begins its growth at once. Not before the seedling has reached a considerable size (6—10 cm), does the "shoot" break off, still with the "comb"-pericarp girding its basal part and serving as an anchor. It floats in the water for a time, and in this way the species becomes dispersed by the currents.

Through the kindness of Mr. Black I have secured a considerable amount of herbarium material of *Cym. antarctica* from Henley Beach, S. A. and from it have been able to control his description of the female flower and fruit, and its behaviour. The detached seedlings I found myself on the West Australian coast, and also got some from Mr. Hamilton from Bunburry; they seem to be commonly cast ashore during the spring. At Carnarvon I happened to find a seedling which was further developed and showed the manner in which the rhizome was formed (Fig. 12). By combining Mr. Black's exhaustive description and my additional observations, we are able to give the following picture of the development of the propagation:


Fig. 14 *Cym. antarctica*, from Henley Beach, S. A. *a*, Female flower with involucrum (*p*) (about $^2/_1$ nat. size). *b*, Longitudinal section through the fruit (about $^3/_2$ nat. size). *c*, Ripe fruit with "comb" and protruding plumula (about $^3/_4$ nat. size).

The female flower consists of two carpels, as in the other species of *Cymodocea;* it is terminal at the apex of the upright branches, and is sheltered by two nearly opposite normal foliage leaves. All this is typical and was seen by Ascherson (1876), but in two points the flower differs from the ordinary *Cymodocea* flower: the styles of the carpels divide into three stigmas (not as usually into two), and the flower is enclosed in a membranous involucrum (Fig. 14 *a*); whether this cup is a kind of perianth or — more probably — bracteoles, I cannot say. According to Mr. Black this involucrum is well developed in his *P. antarctica* and nearly absent in his *P. Griffithii.* The flowers and fruits examined by me all had a more or less well-developed involucrum.

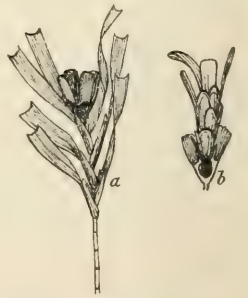


Fig. 15. *Cym. antarctica*, from Henley Beach, S. A. *a*, An erect shoot with leaves and the apical fruit. *b*, A seedling with its "comb"-fruit cleft longitudinally. ($^3/_4$ nat. size.)

After the fertilisation the carpels begin to grow, and especially four small outgrowths on their surface increase rapidly in size to form four flat cuneate spreading lobes. Inside them and more toward the apex of the carpel there are some smaller and more pointed protuberances which form a kind of protection around

the apex (see Fig. 14 *b*). The stigmas and the distal part of the style break off soon after fertilisation while the basal part of the style remains. The wall of the pericarp consists of a thin fleshy outer layer and a hard inner layer, and the fruit is consequently a drupelet, as in the other species. Sometimes both carpels of a flower are fertilized and grow out as fruits (Fig. 14 *b* and *c*), but generally one is abortive (Fig. 15 and 16). As I have had only herbarium material at hand, I cannot say how the embryo develops. On making a section through a fruit, we find a fully grown embryo with a long cotyledon, a short axis and no primary root. This embryo bursts the apex of the pericarp (fig. 14 *b*) and appears as a little seedling (fig. 14 *c*), which by and by becomes larger. For a long time it remains attached to the mother plant. The figures show two different stages; in the first (fig. 15 *b*) the pericarp has been cleft longitudinally to show the base of the seedling inside the pericarp. The first leaves of the seedling have a minute blade and a large sheath, but gradually the size of the blades increases and at last we find, still attached to the apex of the mother shoot, a new shoot 6—10 cm long and with well developed foliage leaves; the apices of these leaves are always truncate and blunt (Fig. 16 *a*). At a certain moment the new plant (the seedling) is loosened from the mother shoot, but it takes the pericarp along with it, and now the pericarp begins to alter, the fleshy outer part decaying while the hard inner layer remains. The hard parts of the four lobes become divided into many parallel bristles, and only now does it really deserve its name of a "comb" (Fig. 16 *b*). The dark green seedlings with their pale yellowish "comb"-bases float in the water until they become anchored in the ground or to some fixed body at the bottom. Then the stem begins to grow more rapidly, and at the same time lateral shoots issue from the lower internodes and produce creeping rhizomes which develop as described above (see p. 22).

Fig. 16. *Cym. antarctica*. *a*, "Seedling" still adhering to the mother shoot, from Henley Beach, S. A.; *p*, remains of the involucrum; *x*, of the abortive carpel. *b*, Detached seedling from Bunbury, W. A. ($^3/_4$ nat size).

This peculiar kind of vivipary here found has — as rightly pointed out by Mr. Black — a certain resemblance to the vivi-

pary in *Bruguiera*, in which plant the seedling also falls to the ground together with the pericarp, while in *Rhizophora* the empty pericarp remains on the mother plant.

The floating power of the seedling makes it possible for it to be carried away by the currents, and in this way the dispersal of the species is furthered. This is an interesting exception to the ordinary rule that sea-grasses do not possess any special adaptation for an effective dispersal of their seeds or fruits. Another exception is seen in *Posidonia australis* (see p. 35), but it is remarkable that these two species nevertheless have unusually restricted geographical areas of distribution.

### 4. **Diplanthera uninervis** (Forsk.) Ascherson,

in Engler u. Prantl, Natürl. Pflanzenfam., Nachtr. (1897) 37; in Das Pflanzenreich, IV 11 (1907) 152; *Zostera uninervis* Forskål, Fl. ægypt. arab. (1775) 159; *Halodule australis* Miquel, Fl. Nederland. Ind. III (1855) 227; *Diplanthera tridentata* Thouars; F. v. Müller, Sec. Census Austral. Plants I (1889) 204.

This species, not previously recorded from West Australia, was found sparingly cast ashore at Carnarvon (No. 261).

The specimens collected were all sterile. They have an elongated creeping rhizome and short-jointed upright leaf-bearing branches, some of which are more or less transformed into younger long-jointed rhizome branches. The leaves are short (4—6 cm long) and moderately broad (varying from 0.5 to 1.5 mm). The apex of the leaf-blade has generally three teeth, the marginal ones being more pointed than the central, which, in the narrower leaves, is not much developed, in some cases wholly wanting, thus making the apex two-toothed.

*D. uninervis* is widely distributed along the tropical coasts of the Indo-Pacific region, extending from the Red Sea to Oceania. As to Australia I have seen specimens of this species from Rockingham Bay ("Dugong Plant") and Port Denison, Queensland, both (unnamed) in the National Herbarium of Victoria. Probably it will be found in other places along the tropical coasts of Australia[1]; on the other hand it can hardly be expected farther south than Carnarvon, the most southerly record hitherto known.

[1] F. v. Müller (l. c., 1889) records it from "N. A.", but I have not succeeded in finding his source for this record, as his quotation, "Fragm. Phytogr. Aust. VIII, 218", only says, that it should be sought for along the tropical coasts of Australia.

### 5. **Posidonia australis** J. D. Hooker,

Flor. Tasman. II (1860) 43; F. v. Müller, Fragm. Phytog. Austr. VIII (1872—74) 218; Sec. Census (1889) 204; Bentham, Fl. Austr. VII (1878) 175; Ascherson, in Das Pflanzenreich IV 11 (1907) 38; *Caulinia oceanica* R. Brown, Prodr. Nov. Holl. I (1810) 339; *C. australiana* F. v. Müller, Fragm. Phytogr. Austr. VI (1868) 198.

Next to *Cymodocea antarctica* this species is the most common sea-grass along the coast of West Australia. It is known from several places between King George's Sound and Sharks Bay.

Outside West Australia it occurs on the coasts of South Australia, Victoria and Tasmania, that is along the whole southern side of the continent, and extending further to the extra-tropical west coast.

It has only one congener, *P. oceanica* (L.) Del., an inhabitant of the Mediterranean. The genus which stands very isolated within the family, is evidently a very old type, and the restricted and discontinuous areas of the two species point to a much wider distribution in former times.

We know the morphology, the structure and the biology of the Mediterranean species comparatively well through investigations by French and Italian scientists[1]. In general the Australian species seems to be similar, but as far as I have seen, little has been written about it, and as I found the plant in fruit and observed the dispersal of the fruits, I think it worth while to publish my observations. Both at Geraldton (No. 269) and at Carnarvon (No. 268) the fruits and leaves of the plant were cast ashore in quantities (28th and 31st Octob. 1914). The following is an extract from my note-book regarding this phenomenon, as it was observed at Geraldton:

"The fringe of cast-up material on the coast at Geraldton consisted mostly of *Posidonia australis*. Besides leaves — both foliage leaves and the short involucral leaves of the inflorescence — the material included numerous fruits of this plant. Most of them had opened. The basal part of the fleshy pericarp had

[1] Ph. Caulinus,: Zosteræ oceanicæ Linnei anthesis, Neapoli, 1792.

Germain de Saint-Pierre, in Bull. Soc. bot. de France IV (1857) 575, et VII (1860) 474.

Ch. Grenier, ibid. VII (1860) 362, 419, 448.

Ad. Brongniart et Arthur Gris, ibid VII (1860) 472.

Ch. Flahault, in Kirchner, Loew u. Schroeter, Lebensgesch. der Blütenpfl. Mitteleurop. vol. I, 1 Abt. (1908) 537.

C. Sauvageau, in Journ. de Botanique IV (1890) 221, 237, et VII (1893) 95.

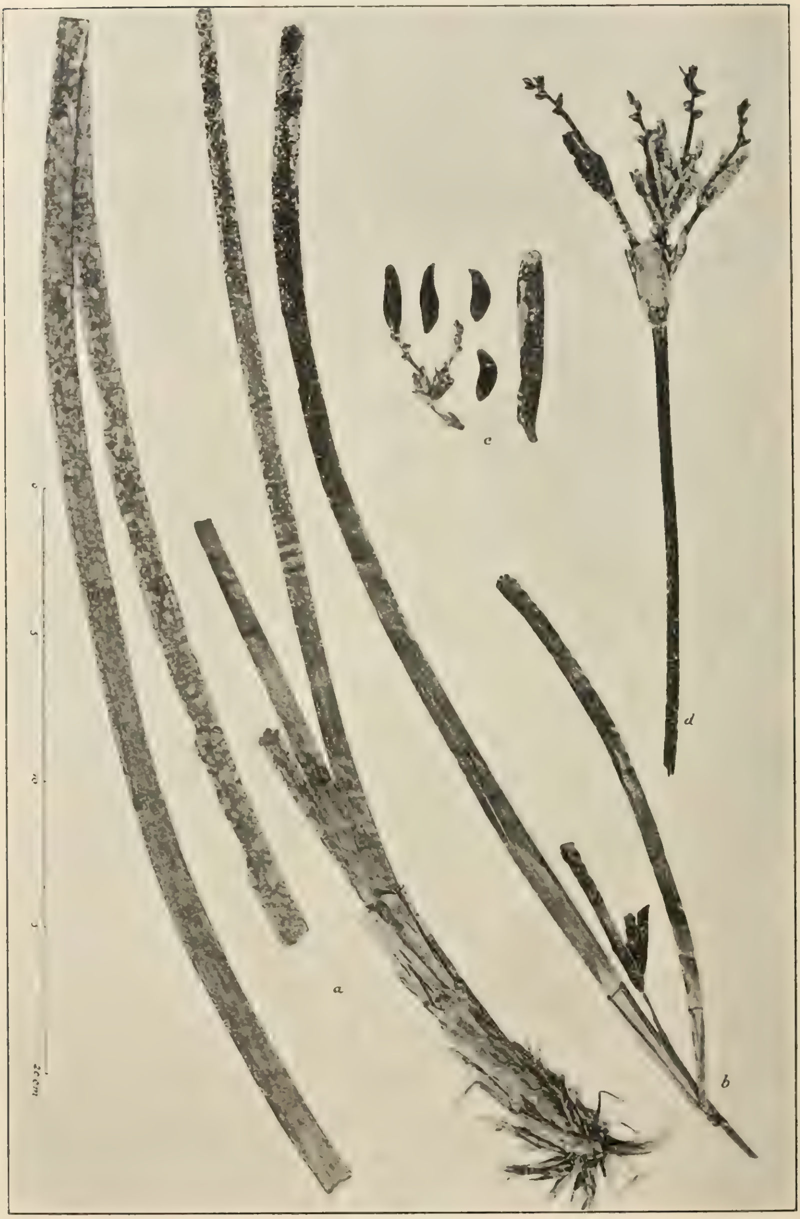

Fig. 17. *Posidonia australis.* *a*, Leaf-blade and upright shoot, from Carnarvon; *b*, Young inflorescence with leaves, from Port Pirie, S. A. (leg. Gunnar Andersson, Aug. 9th 1914); *c*, Inflorescence with ripe fruits and bract, from Geraldton; *d*, Whole inflorescence with bracts and old flowers, the hornlike prolongation of the branches visible; from W. A. (leg. F. v. Müller). (Photo. of herbarium material).

split into 2—3 lobes, and the whole pericarp was spread out as a nearly flat body, thus liberating the seedling which had dropped out. These empty pericarps were present in great masses on the shore, and were also to be seen in immense numbers floating in the water. Amongst the empty pericarps I found several whole fruits which had just begun to open; they are oblique-ovoid in shape and each contains a large green seedling. Unopened fruits were also found, some unripe or barren. Evidently *Posidonia* liberates its fruits when ripe, and owing to presence of air in the tissues of the pericarps they rise to the surface and float. Then they open and the seedling, which is heavier than water, drops out and sinks to the bottom while the pericarp continues to float for a time and then breaks up."

„The thousands of pale green or yellowish green open pericarps, form, together with the leaves, a fringe along the shore, and present a peculiar sight".

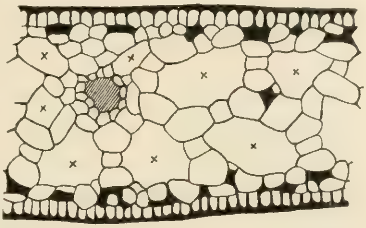

Fig. 18. *Posidonia australis*, from Carnarvon. Transverse section of a leaf-blade. The thick walls of the epidermis and the sclerenchyma-strands are shown in black, the vein (one of the lateral veins) is shaded. ×, lacunæ. (About $^{150}/_{1}$ nat. size.)

A later examination of the material collected and of further specimens from South Australia has added to my notes and allows me to make some additions to the descriptions of the species as given in floras.

The creeping rhizome is short-jointed, and in the axil of each leaf there is a short erect shoot with densely arranged leaves. As in the Mediterranean species, the leaf-sheath (8—12 cm long) persists for some time after the shedding of the lamina; the old sheaths split into fine filaments consisting of the sclerenchyma-strands. Thus the erect shoots become enveloped at their base in a cover of these filamentous remains, but hardly to such an extreme degree as is the case with *P. oceanica.* The leaf-blades are long (up to 65 cm measured) and ribbon-like (5—14, generally 8—10, mm broad) with a truncate apex and entire margins. Their structure is known by the investigations of C. SAUVAGEAU (l. c., 1890), and an examination of my material confirms his description. In a transverse section (Fig. 18) the characteristic points are: a small-celled and thick-walled epidermis; numerous small sub-epidermal sclerenchyma-strands, a lacunose mesophyll with septa formed by several cells, and scattered small

sclerenchyma-strands at the points where the septa between the lacunæ (air-chambers) meet. (The structure of some doubtful *Posidonia*-leaves is dealt with later, p. 37).

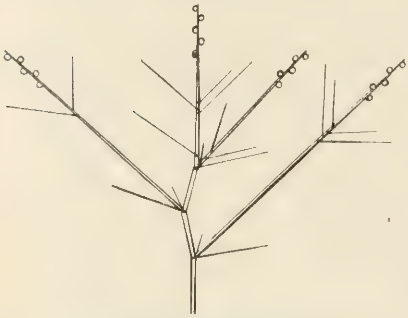

Fig 19. *Posidonia australis.* Diagram of an inflorescence.

The inflorescence is terminal on a long naked axis. It is distichous and branching, and consists of about three branch-spikes and the terminal spike; these are supported by and enveloped in bracts with large sheaths, the leaf-blade being short or absent. A diagram (Fig. 19) of an inflorescence shows the arrangement of the bracts and spikes. The lowermost bract has a blade longer than the sheath, while the blades become gradually reduced in size in passing up the inflorescence. The two lowermost lateral spikes are more or less long-stalked, and their bracts are placed towards the upper end of the axis, while the uppermost lateral spike has its bracts nearly in the axil of the supporting bract of the main axis. All the lateral spikes begin with a short bladeless prophyllum in the axil between the main axis and the branch. The number of bracts immediately supporting the spikes varies from two to four. Each spike bears 4—6 (perhaps sometimes more) flowers placed at some distance from each other; the axis is continued into a horn-like process above the uppermost flower (which consequently is lateral like the other ones).

Fig. 20. *Posidonia australis*, from Geraldton. A lateral fruiting spikelet. (Nat. size).

In *Posidonia oceanica* it is stated that the uppermost flower of each spike is male while the others are hermaphrodite. I have not had flowering material of *P. australis* at my disposal, but to judge from the fruiting specimens all the flowers seem to be hermaphrodite in this species (see Fig. 20). There is no perianth. The broad connectives of the three sessile anthers are persistent on the fruit. Their shape is somewhat variable, being shorter or longer ovate-lanceolate with a broad base and a more or less obtuse apex (not nearly so acute and pointed

as in fig. 12 D of "Das Pflanzenreich", IV 11, p. 37); they differ considerably from the connectives of *P. oceanica* which are broadly obovate-cordate with a long mucro and as a rule are denticulate at the base of the mucro. On their outer face there is a keel on which the pollen sacs were placed, but these are thrown off after flowering (Fig. 21 *a*). The base of the fruit is fringed by the persistent connectives as by a cup-shaped perianth (Fig. 20).

The female organ consists of one sessile carpel terminating in a sessile stigma which is said to be lobed (F. v. Müller (1868): "stigmate sessili . . inæqualiter in lobos 3—4 acutos fisso"; Bentham gives (1878): "a thick 2- to 4-lobed stigma"). In fruiting specimens the stigma is still discernible as a small, somewhat irregular knob. The fruits (Fig. 20) are oblique-ovoid or ovoid-lanceolate, with a fleshy pericarp; the colour is pale or yellowish olive-green, and the dimensions are: length 20—27 mm, breadth 8—10 mm. At maturity the fruits become detached, rise to the surface of the water and float owing to the lacunose aërenchyma of the fleshy exocarp. This part of the pericarp splits irregularly from the base into two or three lobes (Fig. 22 *a*), so that the "stone" drops out and sinks to the bottom as it is heavier than water. The irregular dehiscence of the fruit is comparable of that of the walnut (*Juglans*). The "stone" has no real hard endocarp, only a thin, almost membranous cover for the embryo. The latter protrudes at the apex splitting the membrane into two or three lobes and leaving the way open for the plumule (Fig. 22 *d* and *e*). No seed-testa is discernible in the ripe fruits; it has, probably, been absorbed during the development of the fruit. The embryo is large and highly differentiated (Fig. 22 *f*); it consists of a thick, starch-containing central body (the hypocotylous axis) and a plumule (Fig. 21 *b* and *c*). Probably the main root does not develop much; it is seen as a tap at the lower end of the central body. The first adventitious root appears at an early stage at the base of the plumule, where even in unopened fruits a small protuberance indicates its position (see Fig. 21 *c*).

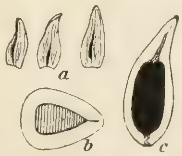


Fig. 21. *Posidonia australis. a*, Connectives of the anthers, pollen sacs thrown off (about $^2/_1$ nat. size). *b*, Transverse section of a fruit (about nat. size). *c*, Longitudinal section of a fruit ($^2/_3$ nat. size).

This description of the fruits and my notes on their dispersal show that they are adapted for distribution by means of water. The same is the case with regard to the Mediterranean species, as appears from the publications of Caulinus (l. c.), Germain

de Saint Pierre (l. c.) and others. In this respect the genus *Posidonia* differs from most of the other sea-grasses, since floating of the reproductive organs is a very rare phenomenon amongst them (cf. *Cymodocea antarctica*).

The Mediterranean species (*P. oceanica*) is very like our Australian one, still it differs in several points as regards the inflorescence, the flower and the shape of the fruit, as well as in the structure of the leaves. *P. oceanica* is said to flower and set fruits only very rarely, while it appears that the Australian species flowers more regularly, and the enormous masses of fruits which I found both at Carnarvon and especially at Geraldton, show that the species set fruits in abundance, at least periodically.

At what time it flowers is not known with certainty, but to

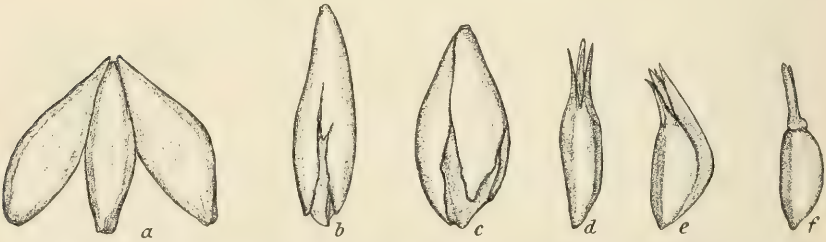


Fig. 22. *Posidonia australis*, from Geraldton. *a*, The irregularly three-lobed exocarp opened. *b* and *c*, Two different fruits, showing the splitting of the exocarp beginning at the base. *d* and *e*, "Stones" of *b* and *c*; the plumule protruding at the apex. *f*, Embryo (of *e*). (About $^5/_4$ nat. size).

judge from analogy with *P. oceanica*, which flowers in the autumn and ripens its fruits in the next spring, the flowering of *P. australis* should take place during the autumn of the southern hemisphere, i. e. in March—May, and the fruits should ripen in the spring, i. e. September—November; the latter supposition is confirmed by the fact that I collected the ripe fruits during the last days of October.

I hope that some Australian botanist will be able to study on the spot the flowering of this species and the development of the fruit, which has several interesting points still unsolved (e. g. the fate of the coats of the ovule).

## Posidonia sp.

I found at Carnarvon, besides the typical broad-leaved *P. australis*, some narrower leaves like those of a broad-leaved *Zostera*.

They were very long; their apex was rounded, not truncate, and they had a much stronger and thicker consistency than the typical ones. I could not find any shoot of this peculiar sea-grass, only the long leaf-blades the bases of which showed that they were thrown off from the sheaths. Two intact leaf-blades were 80 and 105 cm long (thus exceeding *P. australis*, the longest leaf-blade of which was 65 cm). The breadth of the leaves also differs:

| *P. australis* | *P. sp.* |
|---|---|
| 6—11 mm | 3—5 mm |
| (average of 10 leaves: 8.1) | (average of 6 leaves: 4) |

In transverse section (Fig. 23) the aberrant leaves differed in several respects from the leaves of the typical *P. australis*. The epidermal cells have much thicker walls and they are elongated perpendicularly to the surface. The sclerenchyma-strands are more numerous, and while in the typical *P. australis* the strands are practically restricted to a subepidermal layer (besides the few scattered in the septa), in this case they are also common in the outer parts of the mesophyll inside the subepidermal layer. Other interesting points are that the lacunæ in the mesophyll are much narrower than in typical *P. austr.*, and that the ordinary cells of the mesophyll are filled with large starch grains. I have never before met with this rich occurrence of starch in the mesophyll of any sea-grass.

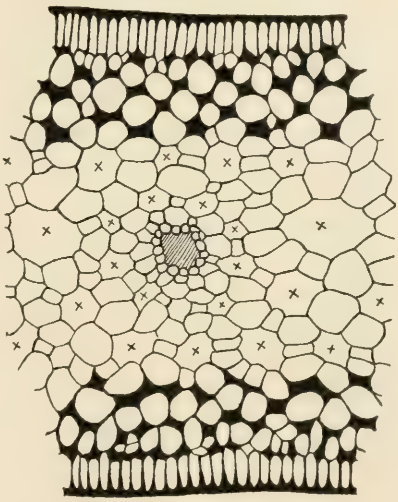

Fig. 23. ***Posidonia sp.***, from Carnarvon. Transverse section of a leaf-blade. For explanation see fig. 18, with which it is comparable. (About $^{150}/_{1}$ nat. size.)

Apart from these differences, the structure of the leaf points to *Posidonia*, and the question is, strictly speaking, whether the aberrant leaves belong to some modification of *P. australis*, or represent a new hitherto unknown species of the genus. The insufficient material at hand does not justify any definite decision at present. I have mentioned it here only to draw the attention of some later observer to this problem which seems worth solving.

## Fam. II. Hydrocharitaceae.

Two species of *Halophila* are found in the sea off the West Australian coast; both of them also occur on the East coast of the continent. They differ considerably from each other in external appearance and both are quite unlike the ordinary ribbon-leaved type of sea-grasses.

### 1. **Halophila ovalis** (R. Br.) J. D. Hooker,

Flora Tasman. II (1860) 45; Ascherson, in Linnæa 35 (1867) 173; Bentham, Fl. Austral. VII (1878) 182; I. B. Balfour, in Transact. & Proc. Roy. Soc. Edinburgh XIII (1879) 290; *H. ovata* F. v. Müller, Fragm. Phytogr. Austr. VIII (1872—74) 219; Second Census Austr. Pl. (1889) 193, et aliis; non Gaudichaud, in Freycinet Voy. Bot. (1826) 430, tab. 40, fig. 1; *Caulinia? ovalis* R. Brown, Prodr. Fl. Nov. Holland. (1810) 339.

As already stated (p. 7) this species was first recorded for West Australia by C. Andrews (l. c., 1902), who found it in Freshwater Bay, Swan River Estuary in 1902 (Fl. of W. Austr., No. 1065), and shortly after it was discovered on the coast of Rottnest Island, off Fremantle (by Markwell). I collected a small piece of it cast ashore at Geraldton (No. 272) and found it growing plentifully in pools on the coast off the Yallingup Cave (No. 273). As to the latter record my diary contains the following remarks: "*Halophila ovalis* inhabited mostly the smaller pools. It often grows so deeply imbedded in the sand, that only the leaf-blades are visible, and in this case the leaves are long-stalked and the shoot-apex with the young leaves is quite hidden, pale-yellow and etiolated. No flower was found". The leaf blades were 24—27 mm long, 10—12 mm broad, and the stalk attained to 40—45 mm long.

The four localities now known are all along the southern part of the west coast of West Australia, and seem to indicate a common occurrence of the species.

*H. ovalis* is widely distributed along the coast of the Indian and Pacific Oceans, and has the widest area of occurrence of all the *Halophila* species. Around Australia it is known from West Australia, South Australia, Tasmania, Victoria, New South Wales and Queensland, and, probably it occurs on all parts of the coast where the conditions permit it to grow.

The specimens collected and also all the other specimens seen from Australia are rather uniform: vigorous and robust with long and large leaves (the blades are 25—50 mm long);

they may be referred to the larger variety which is called *Lemnopsis major* by H. ZOLLINGER (Verzeich. der im indisch. Archipel in den Jahren 1842—48 gesamm. etc. Pflanzen (1854) 74; quoted from Ascherson (1867) 172).

The species seems to vary very much with regard to the size and shape of the leaves, and perhaps some of the more divergent forms are really independent species. But until flowering and fruiting specimens are found in greater abundance than hitherto, it is better to follow ASCHERSON (1867, 200), who united *H. ovalis*, *H. madagascariensis* Steud., *H. major* (Zoll.) Miq., *H. lemnopsis* Miq. (= *Lemnopsis minor* Zoll.) into one species. With regard to *H. ovata* Gaudichaud (l. c.), I have elsewhere (OSTENFELD, in Philippine Journ. of Sc., IV No. 1, Sect. C. Botany, 1909, 67) shown that it is a good species, at present only known from the Philippines and Mariannes.

The morphology of *H. ovalis* has been thoroughly investigated by I. B. BALFOUR (1879), and later the structure of the leaves was studied by C. SAUVAGEAU (Journ. de Botanique IV, 1890, 293).

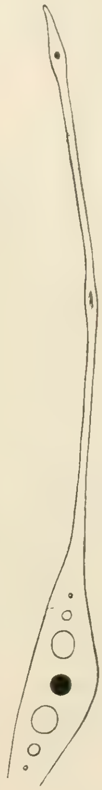

Fig. 24. *Halophila ovalis*, from Yallingup Cave District. Transverse section of part of a leaf. The black dots are the veins (the big one the central vein) and the circles the air chambers. (About $^{20}/_{1}$ nat. size).

Quite recently H. SOLEREDER[1] has examined the structure of the leaves of *H. ovalis* and other species, and has found some interesting features which were overlooked by the earlier authors: The central area of the outer walls of the epidermal cells is thinner than the remaining parts, and when seen from above, a circular spot is more or less distinctly visible. This observation I can corroborate after examination of my West Australian material of *H. ovalis*. SOLEREDER's other discovery is not quite so convincing: The leaves consist only of the two epidermal layers except where traversed by the veins. Between these two layers SOLEREDER found, singly or a few together, some idioblasts which he calls "Schlauchzellen". My material showed here and there smaller cells between the two epidermal layers, but they did

[1]) H. SOLEREDER: Systematisch-anatomische Untersuchung des Blattes der Hydrocharitaceen. — Beih. Botan. Centralbl., Bd. XXX. 1. Abt. 1913, pp. 24—104.

not differ in any important point from the other cells, and to me they appear to be only cells produced by a more or less irregular tangential division of the epidermal cells. Around the veins, especially around the middle vein, the leaves are more than two layers thick, and air chambers are present around the middle vein (Fig. 24). The lateral walls of the epidermal cells of both surfaces are much undulated, less so above and under the veins.

### 2. **Halophila spinulosa** (R. Br.) Ascherson,

in Neumayer, Anleit. z. wiss. Beobacht. Reisen, 1. ed. (1875) 368; 3. ed. (1905) 395; Bentham, Fl. Austr. VII (1878) 183; F. v. Müller, Sec. Census Austr. Pl. (1889) 193; *Caulinia? spinulosa* R. Brown, Prodr. Fl. Nov. Holland. (1810) 339; F. v. Müller, Fragm. Phytogr. Austr, VIII (1872—74) 219 and 283.

Many specimens of this rare species, which was not before known from West Australia, were found cast ashore at Carnarvon (31st Oct. 1914; No. 274); some specimens were sterile, others bore male flowers (Fig. 25).

The first more complete account of this species was given by F. v. Müller in Fragm. VIII, 219. He described the vegetative part of the plant and the fruit, but owing to a misinterpretation of the thread-like apical prolongation of the fruit, he believed that the plant had "stylo setaceo stigma simplex dimidio crassius depressum gerente". No doubt he had only the fruit with its long process before him, after the stigmas had withered and were thrown off. His "depressed stigma" is the rudimentary perianth, first seen by I. B. Balfour (l. c.) in *H. ovalis*; and arising from it we must imagine the stigmas — probably three in number and filiform as in other *Halophila* species. The above misinterpretation led F. v. Müller to suggest a separate genus for the species in question, but in an addition to the same volume (VIII) of his "Fragmenta" he places it (p. 283) "juxta Halophilam".

A good description of specimens from the same collection was given by Bentham in Fl. Austr. (l. c.).

F. v. Müller did not find any male flower, and I have seen no description of it at all. Bentham (l. c.) says: "Male flowers unknown", while Ascherson (1905, 395) mentions "die nur unvollkommen bekannte männliche Blüte", but gives no other information about it. My material contained a number of shoots with male flowers and thus enables me to give a full description of their appearance. The vegetative parts of the plant also show several points of interest which are included in the following description of the whole plant.

As in other species of *Halophila*, there is a transversally creeping, thin and fragile rhizome On its younger parts two membranous and early deciduous amplexicaul scale-leaves are present at each node, from which an erect assimilative shoot and an unbranched root arise. The assimilative shoots attain to 17—18 cm in length, and bear numerous pairs of foliage leaves. These

Fig. 25. *Halophila spinulosa*, from Carnarvon. A Flowering male plant with creeping rhizome and erect assimilative shoots. The flowers are hidden in the upper parts of some of the assimilative shoots. (Photo. of herbarium material).

leaves are opposite and distichous, and are turned in such a manner that they stand edgewise; therefore the whole shoot is quite flat. Such a distichous arrangement of opposite leaves is rare, though there is a somewhat similar arrangement in *Potamogeton densus* and in *Euphorbia buxifolia* (cfr. E. Warming, in Bull. Acad. Roy. sc. et lettr. de Danemark, pour l'année 1896).

Fig. 26. *Halophila spinulosa.* A pair of leaves one of which encloses a male flower bud. (3/2 nat. size).

The shoots of *H. spinulosa* (see Fig. 25) have a superficial (ecological) resemblance to the assimilative shoots of some species of *Caulerpa* (e. g. *C. crassifolia*).

The leaves are broad-linear, 13—16 mm long and 3—4 mm broad, with a spinulose-serrate margin, and three parallel veins, besides some very fine anastomosing veins. At the base of the downward-turned side, each leaf has an ear-shaped upwardly bent dilatation with an entire margin (Fig. 26). In this pocket the lower part of the flower, when present, is hidden. The insertion of the two leaves of each pair is exactly opposite; the "ear" is found on the same side of all the pairs; thus on the right half of a shoot all the leaves have the ears turned towards the observer, while he sees the back of all the leaves of the left half. There is, consequently, no alternation as is the case with ordinary opposite leaves.

The structure of the leaves[1] does not show any important difference from those of other species of the genus. The leaves consist of the two epidermal layers only, except round about the veins (Fig. 28). The outer walls are not undulating (faintly undulating on the outer side of the ear-shaped dilatation). Around the middle vein some small air channels are present. The spinulose margin is made up


Fig. 27. *Halophila spinulosa.* Transverse sections of a leaf: *a*, at the middle; *b*, near the base. Air chambers are shown as circles, veins as black dots. (About 20/1 nat. size).

Fig. 28. *Halophila spinulosa.* Transverse section of a leaf. The veins are shown as black dots. x denotes air chambers. (About 50/1 nat. size).

[1] Compare C. Sauvageau, l. c. (1890) 294.

of one-celled acute teeth. A transverse section at the middle (Fig. 27 *a*) shows that the middle vein is somewhat nearer the one margin than the other. This obliqueness is more pronounced in a transverse section near the base where the ear-shaped part is met with (Fig. 27 *b*). Here the middle vein is found in the upper half of the clasping leaf-base.

Fig. 29. *Halophila spinulosa.* The apex of an assimilative shoot, twisted by the pressure of the male flowers. (About $^3/_4$ nat. size).

The first leaves of an assimilative shoot are transitional in form between the scale-leaves of the rhizome and the foliage leaves. The pairs are somewhat distant in the lower part of the assimilative shoot; further up they are more closely placed, partly covering one another.

Probably the assimilative shoots are comparatively short-lived, while the creeping rhizome steadily renews itself by new shoots, the older dying away behind.

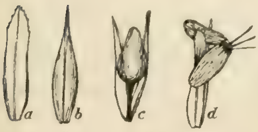


Fig. 30. *Halophila spinulosa.* Male flower. *a* and *b*, outer and inner involucral leaves; *c*, flower bud with involucrum; *d*, open flower with emptied anthers and backwards bent perianth. (About $^3/_2$ nat. size).

Towards the apex of some assimilative shoots male flowers were present in the axils of the leaves, and owing to their presence the regular edgewise arrangement of the leaves is somewhat disturbed. The flowers press the leaves apart, and by this pressure the upper part of the shoot becomes more or les spirally twisted (Fig. 29).

The male flower is placed solitary in the axil of an ordinary foliage leaf, and is enclosed in a two-leaved involucrum (Fig. 30). The outer involucral leaf is nearly two-keeled (one acute and one blunt angle) with a flat back; towards its apex it is somewhat spinulose-serrate (Fig. 30 *a*). The inner involucral leaf encloses the flower bud; it is one-keeled and has a long-pointed apex (Fig. 30 *b*). The flower itself consists of three perianth leaves which, when they open, bend backwards and force the edgewise-set leaf a little aside. The perianth leaves are obtuse ovate-oblong faintly one-nerved. Inside the peri-

Fig. 31. *Halophila spinulosa.* Transverse section through a male flower, showing the two involucral leaves, the three-leaved perianth and the three anthers. (About $^{25}/_1$ nat. size).

anth are the three four-locular sessile anthers (Fig. 31) which are cast off when emptied, but the central strands remain for some time (Fig. 30 *d*). The pollen is moniliform (confervoid) as in other *Halophila* species (see I. B. BALFOUR, fig. 52); the cell walls are gelatinous and swell in water.

The female flower has the same position, and is enclosed in two involucral leaves of the same shape as in the male flower. It consists of an ovoid ovary with a long filiform process on the apex of which the rudimentary perianth and the three filiform stigmas are supposed to be placed (cf. p. 40). I have seen herbarium specimens of female plants in the collections of the Imp. Botan. Garden of Petrograd and of the Roy. Botan. Garden, Calcutta, both from Port Denison, Queensland, and both with young fruits. The fruits were placed below the middle of the assimilative shoot, not at the apex as in the case of the male flower. But this difference may be due to later development, the assimilative shoot having continued its growth after the flowering time. According to F. v. MÜLLER the seeds are globose, transparent and smooth.

The features given above indicate that *H. spinulosa* does not differ from the other species of the genus in floral characters. As regards the vegetative parts, the rhizome and the shoot-formation follow the type, but the numerous opposite and distichous leaves are peculiar.

The species is known from several places on the north and east coasts of Queensland, from the Philippines, and I have also seen specimens from Java (Andjer, leg. Andrea, 1868). Probably it has a wider distribution in the Melanesian region, a suggestion which is strengthened by the discovery of its occurrence at Carnarvon.

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1917

# Studies in the Agarics of Denmark[1].

## Part III.

**Pluteus. Collybia. Inocybe.**

By
**Jakob E. Lange.**

With three plates.



## THE GENUS PLUTEUS.

*Pluteus* is one of the best defined genera of the whole mushroom-family. While most other genera are rather heterogeneous, — being made up of different series or groups, some of which show so strong affinity to other genera that they might almost as well be removed to a neighbouring genus — a *Pluteus* is always a Pluteus and nothing else. — From *Volvaria*, with which it has most in common, the genus is clearly distinguished by its total want of a volva. And *Pluteolus* (the genus next in kind in the opposite direction) not only differs from Pluteus by the ochraceous and ellipsoid spores, but also by a totally different texture of the gills (want of inflated cystidia etc.).

Pluteus is a truly xylophilous genus. But while the larger species almost exclusively grow on rotten stumps and trunks, the smaller ones, such as hispidulus, semibulbosus etc., may also be found growing on the ground (but only where the soil is made up of leaf-mould, rotten twigs, peat or other decaying vegetable matter).

[1]) Part I of these Studies (General Introduction. The Genus Mycena was published in »Dansk Botanisk Arkiv« Vol. I no. 5 (1914), part II (Amanita, Lepiota, Coprinus) in vol. II no. 3 (1915).

»Danmarks Agaricaceer« now comprises about 900 watercolour-plates, all painted by the author. For further particulars see part I.

The number of Plutei found in Denmark is comparatively large. While Fries (in »Hymenomycetes Europæi«) does not mention more than 15 species found in Sweden, the total number of Danish species is at least 18. But this is not to be wondered at, considering that the beech (Fagus) is the favorite host of most species, and Denmark is particularly rich in beechwoods. (Of course it must also be taken into consideration that a number of »new« species have been detected since the time of Fries).

Of these 18 Danish species only two (cervinus and nanus) are common, and most of the others are exceedingly rare or at least very sporadic. Two of the Danish species (*P. roseo-albus* and *P. leoninus*) I have never met with during 25 years of investigation (P. roseo-albus has not been seen here for more than a century!), and several others I have only found once or twice. What also causes no little difficulty to the study of the Plutei is their solitary occurrence: It is very rare to find a number of these fungi growing together and thus to get specimens in different stages of development for comparison and figuring. Thus *P. umbrosus* and *P. phlebophorus* are wanting in my collection, as the specimens found by me have not been in a stage fit for portraying.

Still I have succeeded in figuring some 14 species, besides some fairly distinct varieties (17 plates in all) or more than Fries himself had ever seen alive.

The Fries'ian idea: to divide the genus into groups according to the texture of the cuticle of the cap, I believe in the main the right one. But being confined to macroscopic investigation Fries was not able to draw the boundary-lines between the tribes with sufficient exactness. — Fries, it will be remembered, arranged the species in three groups: the fibrillose, the atomate and the glabrous species. The microscopic examination however clearly shows that there are in fact only two main types: a) the species in which the cuticle is of fibrillose texture and b) those in which it is granulose, being made up of subglobular, inflated cells.

In the first group, which I shall term *Tricholomatæ*, the cap varies from almost smooth and silky (*P. pellitus*) to very rough, pilose or squamulose (extreme forms of *P. cervinus*). In the other group, *Micaceæ*, the cap is sometimes covered with glittering »meal« (*P. semibulbosus*), while in other cases it is smooth

and naked, as the globate cells do not fall apart but from a thin homogeneous cuticle (*P. chrysophæus* etc.). The fibrillose or cellular texture of the epiderm can be ascertained by means of a good pocket-lens, as the reflection from the globate cells gives to the latter type a micaceous hue. — A transition from one type to the other is formed by those species in which the terminal cells of the fibrils are inflated (clubshaped or almost ovate). Such species (f. inst. *P. plautus*) appear to the naked eye as having a somewhat velvety bloom on the surface of the cap.

The spores are of smaller value for systematic purposes their ontline and size varying but little (from almost spheric to broadly oval). In the subglobose spore the proportion of the long and the short diameter is about 4 : 3 or 5 : 4; in the oval about 3 : 2.

But the cystidia are very characteristic in this genus. In all the species examined cystidia have been found, and they are generally large and inflated. But while in most cases the edge of the gills is densely set with rather plain-looking, obtuse, inflated-clubshaped or subfusoid cystidia, the sides of the gills are in some cases adorned with ventricose, somewhat bottle-shaped cystidia, crowned with 2—5 hook- or thornlike excrescences. In other species the inflated cystidia have a shorter or longer hairlike appendix. Numerous investigations have convinced me that the shape of the cystidia is a constant character and consequently of great systematic value, as it is of a much more precise nature than colour-shades and the like characteristics, on which one hitherto chiefly had to rely for singling out the different species. Thus f. inst. P. salicinus and the rather similar P. cinereo-fuscus can at once be distinguished in this way.

Making use of the microscopic characters for defining the main divisions of the genus a Key can be constructed that will serve as a comparatively easy means to the identification of any species met.

# KEY

## TO THE SPECIES OF THE GENUS *PLUTEUS* FIGURED IN »DANMARKS AGARICACEER«.

A. **Tricholomatæ**. Cuticle smooth or pilose-squamulose, made up of filaments.

α. Coronatæ. Cystidia (on sides of gills) crowned with 2—5 hooks or corniculate excrescences. Spores broadly oval.

a. Cap soot-brown or gray.

1. Cap paler or darker soot-brown, large (6—10 cm) . . *P. cervinus* (1)
2. Cap glaucous-gray, smaller (4—5 cm) . . . . . . . . . *P. salicinus* (2)

b. Cap whitish.

1. Cap very large and fleshy (8—15 cm broad) . . . . *P. petasatus* (3)
2. Cap smaller (5—7 cm) . . . . . . . . . . . . . . . . . . *P. pellitus* (4)

β. Depauperatæ. No hooked cystidia. Spores subglobate.

a. Cap whitish, set with small, dark squamules.

1. Cap 2—4 cm, slightly squamulose.
   * Cap becoming minutely squamulose all over, squamules dirt-brownish . . . . . . . . . . . . . . . . . . . *P. gracilis* (5)
   ** Cap slightly pilose-squamulose in the middle . . . *P. Roberti* (6)
2. Cap 1 cm, everywhere densely clad with fuscous, pilose squamules . . . . . . . . . . . . . . . . . . . . . . . . *P. hispidulus* (7)

b. Cap dark umber or gray, velvety pruinose.

1. Cap dark umber, velvety. Cystidia without hairlike appendix.
   * Edge of gills not dark . . . . . . . . . . . . . . . . . *P. plautus* (8)
   ** Edge of gills fuscous . . . . . . . . . . . . . . . . *P. umbrosus* (9)
2. Cap gray, with a powdery bloom. Cystidia often with a hairlike appendix . . . . . . . . . . . . . . . . . . . *P. cinereus* (10)

B. **Micaceæ**. Cuticle smooth or somewhat mealy, formed of subglobular cells. Spores almost spherical.

α. Cap white, surface micaceous-mealy . . . . . . . . . . *P. semibulbosus* (11)

β. Cap coloured, pruinate or almost naked.

a. Margin translucidly striate. Cap small (2—3½), pale gray . . . . . . . . . . . . . . . . . . . . . . . . . . . *P. Godeyi var.* (12)

b. Margin not striate.

1. Cap cinereous, rather large (3—4½ cm) . . . . *P. cinereo-fuscus* (13)
1. Cap soot-brown or yellowish.
   * Cap soot-brown.
     † Stem white . . . . . . . . . . . . . . . . . . . . . . *P. nanus* (14)
     †† Stem (and young gills) flushed with lemon-yellow . . . . . . . . . . . . . . . . . . . . . *P. n. var. lutescens*
   ** Cap yellowish-cinnamon . . . . . . . . . . . . *P. chrysophæus* (15)

# SYSTEMATIC AND FLORISTIC NOTES.

## A. TRICHOLOMATÆ.

### α. CORONATÆ.

#### 1. **P. cervinus** (Schaeff.).

Spores broadly oval (or subrotund-ovate), generally $7-7\frac{1}{2} \times 5-5\frac{1}{2}\ \mu$. Cystidia on edge of gills: inflated, obtuse or somewhat pointed, 20—25 μ broad; on the sides: bottleshaped-fusoid, about 15—16 μ broad, apex with 3—4 hooks

Figured specimens: Hjallese, on stump of Fagus, Oct. 1895. — Common, but solitary, especially on rotten stumps of Fagus, but also to be met with in coniferous woods.

This is (a rather dark specimen of) the typical form of this species, in which the cap is almost smooth, the stem, especially downwards, clad with more or less fuscous fibrils (in small specimens almost entirely white). — But besides this common type I have met with several others. On a big heap of sawdust (at Ry, Jylland) I have found a very robust form which was very much like Cooke's figure of *P. eximius* (Saund. et Smith) except for the want of the miniate edge. — And in a hedge (Hjallese) I have seen a large form (which might be called var. *scaber*) in which the stem was everywhere set with black woolly squamules *à la* Boletus scaber, but coarser.

[*P. umbrosus* (Pers.) sensu Bresadola (Fungi Tridentini tab. 116) which is very closely related to P. cervinus, especially the last-named variety, I have never met. Its corniculate cystidia show that it belongs here and distinguish it from P. umbrosus (auct. div.), no. 9.]

#### 2. **P. salicinus** (Pers.).

Spores broadly ovate, $8 \times 5\frac{1}{2}\ \mu$. Cystidia on edge: inflated clavate, 16—18 μ broad; on sides: fusoid-bottleshaped, with hooks. Basidia 4-spored. Filaments on umbo about 12 μ diam., formed of elongated cylindric cells with pale fuscous content.

Fig. specim.: Søby Søgaard, in wood, on a rotten branch (of Fagus), Sept. 1913. Also found at Lammehave (1913) and on Salix capræa in wood near Kværndrup, Sept. 1916.

Fairly typical. Chiefly distinguished from small specimens of P. cervinus by its glaucous-gray, in the middle slightly fuscous-squamulose cap. — P. salicinus in the sense of Ricken does not belong here but to group β.

#### 3. **P. petasatus** Fr.

Spores broadly oval $7\frac{1}{2}-9 \times 4\frac{1}{2}-5\ \mu$. (1914: $7-7\frac{1}{2} \times 5$). Cystidia fusoid-bottleshaped, 11—14 μ broad, apex with some few

hooks. The edge of the gills is sparingly set with obtuse, inflated cystidia. Filaments on umbo formed of about 8—10 μ broad cells, which are sometimes slightly fuscous (1914)].

Fig. specim.: Korint, on big heap of sawdust, gregarious, subfasciculate; fig. B. specimens (from a very sunny place) with the cuticle scorched and broken up into dark, fuscous, broad scales, Oct. 1899. Also found near Gelsted, on heap of sawdust, Oct. 1914.

4 a. **P. pellitus** (Pers.).

Spores broadly ovate, 6—7 × 4—5 μ. Cystidia on sides: subfusoid, with hooks, on edge: inflated obtuse.

Fig. specim.: Kirkeby, on stump of Fagus, Oct. 1909. Also found in similar locality at Skjoldemose (1900) and Korsør (Sept. 1902). It is not clearly distinguished from pale forms of P. cervinus.

4 b. **P. pell.** *var.*

Spores subrotund-oval, $7^1/_2 \times 5^1/_2$ μ. Cystidia as in type.

Fig. specim.: Fruens Bøge, on the ground under old beeches, solitary, Aug. 1914.

A slender form (cap $4^1/_2$ cm, stem about 7 cm), the white cap everywhere sparingly clad with very minute, dark fibrils, which on the umbo become denser and form small, fibrillous, erect squamules. This variety forms a transition to P. Roberti. — P. Roberti in the sense of Ricken appears to be this form.

β. DEPAUPERATÆ.

5. **P. gracilis** Bres. (as a variety of *pellitus*).

Spores oval-globose, $6^1/_2$—7 × $5^1/_2$—6 μ. Cystidia on edge (occasionally also on sides of gills) inflated clubshaped or somewhat fusoid, about 18 μ broad. Surface of cap formed of cylindric or somewhat inflated cells (about 90 × 16 μ) which at last become somewhat brownish.

Fig. specim.: Aarslev, on old pollarded Populus canadensis, Oct. 1916.

The description given by Bresadola fits my plant very well. But to judge from the cystidia it cannot be retained as a variety of P. pellitus. — The other variety, *punctillifer* Quél. (mentioned in Saccardo Syll. V 668) appears to be almost identical, except for the uncommonly small spores.

6 a. **P. Roberti** Fr.

Spores ovate-globose, $6^1/_2$—8 × $5^1/_2$—6 μ.

Fig. specimens: Fruens Bøge, solitary on rotten stump of Fagus, Oct. 1899.

6 b. **P. Roberti** var.

Spores almost globose, 7—8 × 6—7 μ. Cystidia inflated cylindric-ellipsoid, 14—19 μ broad.

Fig. specim.: Fruens Bøge, on rotten twig in foliaceous wood. July 1900. Cap convex-campanulate, small (12 mm). This form is intermediate between P. Roberti and P. hispidulus.

(As I have not had the opportunity to examine this species for many years I am not quite certain about its absolute want of hooked cystidia. But to judge from its close affinity to P. hispidulus it is not likely to have any such). (Vide also no. 4 b.).

7. **P. hispidulus** Fr.

Spores almost globular, $5^1/_2$—7 × 5—$5^3/_4$ μ. Cystidia inflated-club-shaped, 13—16 μ broad.

Fig. specim.: Killerup, foliaceous copsewood, solitary on the ground (moist leaf-mouldy soil), Sept. 1905.

This elegant little species is well characterized by the soot-black hairs which almost entirely cover the whitish cuticle. In the middle they form erect, pilose squamules, towards the edge adpressed, hairy fibrils.

8. **P. plautus** (Weinm.).

Spores oval-subglobose, 7—$8^1/_2$ × 6—7 μ. Cystidia on edge 16—24 μ broad, fusoid-ventricose, without hooks. The sides of the gills are very sparingly set with similar cystidia. The filaments on the surface of the cap are obtuse inflated cylindric, 14—24 μ broad, pale fuscous-brownish.

Fig. specim.: Hjallese, on rotten trunk of Picea, Oct. 1901 (and Aug. 1902). Also found in same locality Aug. 1913 (a paler, less strongly umbonate and smaller specimen).

9. **P. umbrosus** (Pers.).

Spores ovate-globose, $5^1/_2$—6 × 4—5 μ. Cystidia on edge fusoid-bladder-shaped, 15—25 μ broad; content yellowish-brown.

Not figured. Found at Hjallese, on rotten stump of Populus in outskirt of wood, Sept. 1897, and on stump of foliaceous tree, Trolleborg, Oct. 1900. — The cap was about 4 cm broad, the stem somewhat fuscous. This plant is very well described by Ricken (l. cit. p. 278). It seems to me very closely related to P. plautus, (almost like P. umbrosus (sensu Bresadola) to P. cervinus). But which of the two is the true *Ag. umbrosus* of Persoon I cannot decide (vide page 5).

10. **P. cinereus** Quél.

Spores subglobose-ovate 7 × $5^1/_4$ μ. Cystidia inflated, with or without a hairlike appendix of varying length. Cells from

surface of cap inflated and obtusely fusiform (varying from sub-cylindric to almost lemonshaped), about 15—18 μ broad.

Fig. specim.: Hjallese, copsewood on boggy, peaty bottom, solitary, Sept. 1906. Also found on rotten stump of Fagus, »Fjellebro«, Sept. 1912, and on leaf-mould (rubbish-heap in shady place) Hjallese, Sept. 1915 and 16.

This little species is macroscopically well characterized by the gray stem, everywhere covered with white, furfuraceous down. The cap is often more expanded than in the figured specimen, always lacunose-rugose about the umbo.

(To this section also belongs *P. phlebophorus* (Dittm.), which has been met with in several localities (on stumps of Fagus) here in Denmark. When typical it is very characteristic, having the entire cap covered with raised lines or rather minute, wavy, irregularly anastomosing ridges, which radiate from the middle and almost reach the edge. These ridges are set with inflated-fusoid cystidia like the gills. — It is figured (very carefully) by DITTMANN in STURM's Deutschl. Flora, tab. 15.).

## B. MICACEÆ.

### 11. **P. semibulbosus** (Lasch).

Spores ovate-subglobose, 6—7 × 5—5$^1/_2$ μ. Basidia 4-spored. Cystidia obtuse, elongated-cylindric, very prominent, about 13—14 μ broad, entire length 75—115 μ. Cells on surface of cap ovate-subglobose or almost spheric, 25—35 μ in diameter.

Fig. specim.: Hjallese, in wood of Fagus and Populus, on the ground, Oct. 1907.

This little species has the cap densely covered with micaceous »meal«. It is entirely white, campanulate-subglobose, and everywhere sulcato rugose.

### 12. **P. Godeyi** Gill. (?) *var.*

Spores subglobose-ovate, 7$^1/_2$ × 6 μ. Cystidia subovate or inflated clubshaped, 12—25 μ broad. (1901: spores subglobose, 6$^1/_2$—8 × 5$^1/_2$—6$^1/_2$ μ; cystidia inflated fusiform).

Fig. specim.: Hunderup, drive in foliaceous wood, on the ground, Sept. 1909. The figured specimen is very small. At Vormark, 1901, on the ground under Salices and Populus, I have met with specimens of the normal size (cap 3$^1/_2$ cm). — The translucidly striate margin distinguishes this species from almost all others.

I have also met with a slender, small, almost white, slightly fuscous-powdered form (cap about 2 cm, stem 4 cm). This little mushroom may be regarded either as a pallid form of *P. Godeyi* or as a reduced albino-variety of no. 14.

13. **P. cinereo-fuscus** J. E. Lange. (*P. nanus var. major* Cooke). Plate III fig. 1.

Spores subglobose-oval, 8—10 × 6—7 μ. Cystidia rather obtuse, inflated fusiform or ellipsoid, hyaline, 12—13 μ broad. Cells from surface of cap globular, subfuscous, 35—50 μ diam. — The cystidia on the sides of the gills similar to those on the edge (1914). 1916: Spores $7^1/_2$—$8^1/_2$ × $5^1/_2$—$6^1/_4$; cells on cap 25—45 μ.

Fig. specim.: Fruens Bøge, gregarious, on heap of leaf-mould Oct. 1897 (and 1898—1916). — Also found on leaf-mouldy ground, Hjallese, Aug. 1912 and Aug. 1914.

This plant undoubtedly is identical with P. nanus forma *major* Cooke (Illustrations, plate 305 c), but is — I think — better conceived as a distinct species, differing from P. nanus not only by its larger size but also by the characteristic glauco-cinereous colour (almost like P. salicinus). I add a brief diagnosis.

*Pileo 3—5 cm lato, ex subcampanulato expanso, sub lente micaceo-pulverulento, glauco-cinereo (umbo subfuscus), sub-hygrophano, margine leviter rugoso-striato; stipite 6—8 cm × $^1/_2$ cm, cavo, albo, nudo, sericeo-substriato; lamellis subconfertis, ex albo salmoneo-subroseis. Sporæ et cyst. ut supr.*

14 a. **P. nanus** (Pers.).

Spores almost globose, 7—$7^1/_2$ × 6—$6^1/_2$ μ. Cystidia cylindric-bladdershaped.

Fig. specim.: Hjallese, on the ground in mixed copsewood, Sept. 1897, solitary. — Rather common, as well on the ground as on rotten stumps.

14 b. **P. nanus** var. **lutescens.**

Spores almost globose, $6^1/_2$—7 × $5^1/_2$—6 μ. Cystidia cylindric-bladdershaped, 11—25 μ broad. — Cells on surface of cap globular, 30—45 μ diam. (1915).

Fig specim.: Revninge, in the head of an old pollarded Populus, Oct. 1899. — Also Ollerup (on stump of Populus) and in other localities.

15. **P. chrysophæus** (Schaeff.).

Spores subglobose, $6^1/_2$ × $5^1/_2$ μ. Cystidia obtusely fusiform, subventricose, inflated. Cuticle formed of subglobose yellowish cells (about 30 μ diam.).

Fig. specim.: Hollufgaard, on Fagus and Populus, Sept. 1916.

Spores etc. of all the species are figured on plate I.

# THE GENUS COLLYBIA.

*Collybia* is a genus fairly well separated from the adjoining genera. From *Mycena* it is distinguished macroscopically by the generally rather flat cap with slightly incurved edge and microscopically by want of the cystidia characteristic to this latter genus. (In most Collybias the gills either have no cystidia at all or inconspicuous hairshaped ones). — Some neighbouring species of *Clitocybe* differ in having subdecurrent gills, while in Collybia they are generally adnexed. Still it appears to me not unlikely that it would be preferable to transfer to Collybia some of the *Clitocybe difformes* (Fries). Their gills are not truly decurrent and their stem is tough and elastic almost as the stem of a genuine Collybia. But as any deviation from the old established nomenclature and classification (if it be not a marked improvement) should be avoided, I leave them in Clitocybe.

Also some species of *Tricholoma* show strong affinity to Collybia. This is especially true of *T. melaleucum* and its allies. In fact *Agaricus stridulus* Fr. — which the author places in Collybia — evidently belongs to the *melaleucum*-tribe and should not be kept apart from it. To make as little derangement as possible I therefore shall transfer Ag. stridulus to Tricholoma and place it with its numerous relatives. To Tricholoma I also refer the ambiguous *Ag. leucophæatus* Karst., which the author at different times has placed in Collybia, Tricholoma and Lyophyllum. Within the genus *Naucoria* the little tribe which might be called »Pisciodoræ« also shows a marked affinity to Collybia. These very intimately related species are now by most authors scattered about, in a very unsatisfactory way, in different genera (Collybia, Nolanea, Naucoria). From the genus *Nolanea*, as now understood, they are excluded by having smooth spores. But the

question remains whether it would be preferable to place them in *Collybia* or *Naucoria*. In all the species the spores are (sub micr.) hyaline, and in some of them the sporedust is white or at least pale cream-coloured (*Collybia mimica* Smith and other species). But as the most common representative of the genus, *Ag. Cucumis*, has somewhat ferrugineous or incarnate-tawny sporedust, and all of them have large conic-subulate cystidia, I dare not at present place them in Collybia. Probably the best plan will be to include them in Naucoria as a special tribe (*Collybiopsis* or *Pisciodoræ*).

My reasons for transferring *Armillaria mucida* to Collybia are stated in part II of these studies. I notice that RICKEN (Die Blätterpilze) has adopted the same view (which was, I believe, first propounded by QUÉLET (Flore mycologique)).

In another direction Collybia shows very strong affinity to *Marasmius*. In fact the line of demarcation is in several places very difficult to discern. In doubtful cases I generally refer to Marasmius any species with thick and firm gills, while those with membraneous and crowded gills are retained in Collybia. Thus *Agaricus confluens* (= Marasmius argyropus) I place in Collybia. To lump the two genera in one, as KARSTEN does, appears to me rather rash.

But although fairly well separated from the adjoining genera the Collybias do not form a natural series of closely related species, but are rather heterogeneous. Such fungi as f. inst. *Collybia radicata* — *C. velutipes* — *C. racemosa* have certainly not very much in common. Still I shall not attempt to divide the genuine Collybias into subgenera. The old Friesian classification cannot, I believe, be much improved upon. Of his groups *Vestipedes* is the most unsatisfactory one, uniting, I think, too heterogeneous species and separating others which ought not to be kept apart (f. inst. *C. tenacella* and *C. conigena*). This group I have therefore partly disbanded.

With regard to the microscopic characteristics Collybia shows less variety than f. inst. Lepiota. As mentioned above cystidia are wanting in a good many species, and in most others they are rather inconspicuous, hairshaped or like short hyphæ on the edge of the gill. But in a few instances we find more characteristic cystidia. Thus *C. radicata* has large sack-shaped cystidia, in *C. velutipes* they are obtusely fusiform and in *C. tenacella* they are often more or less hooded. — The spores

are much more diversified and often afford an excellent means for identification. Not only they differ widely in size (from 16 × 10 μ down to 3 × 2 μ) and shape (from narrow ellipsoid to almost spheric), but in some few species they also deviate from the ordinary type by being verruculose or sub-spinulose. Two-spored basidia — as in numerous species of Mycena and Omphalia — I have never observed in this genus.

The number of species found and figured in »Danmarks Agaricaceer« is 28. This is not alle the Danish species. Sev. Petersen (loc. cit.) enumerates several others While some of these are very doubtful natives (or very dubitable species) others are distinct and really belong to our flora. Thus f. inst. *C. longipes*, *C. globularis* and *C. Micheliana* have been found by him and other mycologists, but I have not seen them.

# KEY

## TO THE SPECIES FIGURED OF THE GENUS *COLLYBIA*.

### I. ARMILLARIA.

The stem with a distinct ring.

Surface of cap gelatinous. Spores very large, globose . . . *C. (Armillaria) mucida* (1)

### II. EU-COLLYBIA.

No trace of veil or ring.

A. **Læticolores**. Gills generally white or yellowish.

α. Striæpedes (Fries). Stem distinctly striate or grooved; rather large fungi, (stem 5 mm or more).

a. *macrosporæ*. Spores large (6 μ or more broad).

1. Spores about 10 μ broad; stem generally with a long tapering »root«. . . . . . . . . . . . . . . . . . . . . . . . . . *C. radicata* (2)
2. Spores 6—7 μ broad; stem truncate with creeping, white root-like mycelium-strings . . . . . . . . . . . . *C. platyphylla* (3)

b. *microsporæ*. Spores rather small (less than 5 μ broad).

1. Spores globose.
   * Whole plant, when fresh, white or pale yellowish *C. maculata* (4)
   ** Cap rufous . . . . . . . . . . . . . . . . . . . . . . . . *C. distorta* (5)
2. Spores ovate or ellipsoid.
   * Stem somewhat conical; gills crowded . . . . . . . *C. butyracea* (6)
   ** Stem sub-fusiform, rooting· gills distant. . . . . . . *C. fusipes* (7)

β. Lævipedes (Fries, extended). Stem almost even; small or medium-sized fungi (stem 0,5—5 mm broad).

a. *viscidæ.* Cap viscid; Stem velvety, yellow to dark brown. *C. velutipes* (8)

b. *siccæ.* Cap not viscid.

1. Stem glabrous (or slightly pruinose).

⁎ Stem without a long »root«.

† Spores small (about 5 μ long).

= Cap medium-sized ($2^1/_2$—5 cm); gills whitish (rarely pallid ochraceous . . . . . . . . . . . . . *C. dryophila* (9)

≡ Cap small (2 cm); whole plant yellow . . . *C. macilenta* (10)

†† Spores larger (7—8μ long) granulate. Cap fulvous. *C. nitellina* (11)

⁑ Stem with a long »root« springing from cone of Picea . . . . . . . . . . . . . . . . . . . . . . . . . . . . *C. tenacella* (12)

2. Stem flocculose or felty.

⁎ Fasciculate, growing on the ground (dead foliage). *C. confluens* (13)

⁑ Solitary.

† Growing on rotten mushrooms, cones or on the ground. Spores very small (3—5 μ long).

o Not springing from a sclerotium. Growing on cones (of Pinus . . . . . . . . . . . . . . . . . *C. conigena* (14)

oo Springing from a sclerotium. (Growing on the ground or on mushrooms).

§ Stem without branches, pallid; sclerotium brown or ochraceous.

» Sclerotium dark brown, ellipsoid or pip-shaped . . . . . . . . . . . . . . . . . . . . . *C. tuberosa* (15)

» Sclerotium ochraceous, roundish . . *C. cirrhata* (16)

§§ Stem blackish (with numerous branchlets); sclerotium black . . . . . . . . . . . . . . . *C. racemosa* (17)

†† Growing on dead grass (or sticks). Spores larger (6 μ or more long). . . . . . . . . . . . . . . . . . . *C. stipitaria* (18)

B. **Tephrophanæ** (Fries). Gills gray or pale dingy; cap hygrophanous, sordid. (Vide also no. 17).

α. Spores smooth.

a. Stem with a long tapering »root« . . . . . . . . . . . . *C. rancida* (19)

b. Stem without »root«.

1. Spores ovate or ellipsoid.

⁎ Spores medium-sized (4 μ or more broad).

† Cap not striate; growing on the ground.

o Stem rather stout (4—6 mm) base strigoso-tomentose . . . . . . . . . . . . . . . . . . . . . . . *C. inolens* (20)

oo Stem 3—4 mm, not strigose at base . . . . . *C. murina* (21)

† Cap pellucid-striate; growing on Sphagnum . . *C. clusilis* (22)

⁑ Spores small, $2^1/_2$—$3^1/_2$ μ broad.

† Cap striate, umbonate . . . . . . . . . . . . . . . . *C. miser* (23)

†† Cap not striate.

o Cap. 2—3 cm broad; odour very faint, mealy . *C. ozes* (24)

oo Cap $1^1/_2$ cm, foetid . . . . . . . . . . . . . . *C. mephitica* (25)

2. Spores almost globose (cap striate) . . . . . . . . . . . *C. cessans* (26)

β. Spores verruculose or spinulose.
a Cap striate, dingy brownish . . . . . . . . . . . . . . . . . . *C. erosa* (27)
b. Cap even, dark fuscous . . . . . . . . . . . . . . . . . *C. tesquorum* (28)

# SYSTEMATIC AND FLORISTIC NOTES.

## I. ARMILLARIA.

### 1. **Collybia (Armillaria) mucida** (Schrad.).

Spores globular, 13—18 × 12—16 μ, epispore very thick.

Figured specimens: »Fruens Bøge«, on fallen branch of Fagus, Oct. 1895. — On wounded trunks and dead branches of Fagus (as well when lying on the ground as when still on the tree), even high up (about 15 meter), often growing somewhat fasciculate. It sometimes appears to be a true parasite, but never attacks young and vigorous trees. Found everywhere, till late in the autumn.

## II. EU-COLLYBIA.

### A. LÆTICOLORES.

α. STRIÆPEDES.

### 2 a. **C. radicata** (Relh.).

Spores ovate, 15 × 10 μ. Basidia 4-spored. Cystidia inflated, cylindric-sackshaped, about 20 μ broad.

Figured specimens: Hjallese, wood of Fagus, July 1905; forma arrhiza: Hjallese, July 1903.

Common everywhere in our beechwoods, very rarely met with outside. Although apparently growing on the ground it is, I believe, always a true xylophilous fungus, the »root« always springing from a tree-root, and varying in length according to the depth in which this root is running under the surface. — On superficially-running roots the fungus accordingly has no »root« at all, but only an alliiform swelling at the base. This form:

forma *arrhiza*, I have found at Hjallese, July 1903, and in Aalykkeskov near Odense, 1911. — A more distinct form is

### 2 b. **C. radicata** *var.* **gracilis** J. E. Lange.

Spores as in the typical form. Cystidia about 40 μ long, cylindric-subulate, 2—3 μ broad, base inflated, subovate.

Fig. specim.: Wood of Fagus, Hunderup 1897 (and 1900).

In this variety the cap is only about 2 cm broad, whitish-hyaline and somewhat transparent. The stem is white, somewhat downy, 8 cm high. The gills are subdecurrent. If the awlshaped cystidia are a constant feature, it must be regarded as a distinct species, although macroscopically very much like small forms of C. radicata.

### 3. **C. platyphylla** Fr.

Spores ovate-subglobose, generally $6^1/_2$—$8 \times 6$—$6^2/_3$ μ, epispore thick. (1916: Spores $7^1/_2$—$8^1/_2 \times 6$—7 μ, pedicel somewhat lateral). Basidia 4-spored, clubshaped, 7—8 μ broad. Cystidia sackshaped-clubshaped, about 14 μ broad. — The cells of the fibrils on the surface of the cap are ovate-clubshaped, 12—25 μ broad, content grayish-brown (1916).

Fig. specim.: Hjallese, on and around stump of Corylus, June 1897. — Not uncommon, especially on and about stumps of Corylus, from early summer. The mycelium always forms thick cottonyarn-like white strings. The form *repens* figured by Fries (Icon. sel. tab. 61) shows this creeping mycelium more luxuriously developed than usual, but should certainly not — as done by Saccardo (Syll. fung. V.) — be put up as a distinct species.

### 4. **C. maculata** (Alb. et Schw.).

Spores almost globular, $4$—$5^1/_2 \times 3$—$4^1/_2$ μ. (A.)

Fig. specim.: A) Aarup, wood of Picea, Oct. 1896. B) Trolleborg, open grassy space about a wood of Picea, Sept. 1897.

Not rare in woods of Picea and in adjoining open spaces among grass and heather. Figure A. represents the main type: the stout-stemmed form with almost pure white, rather small cap. Fig. B. is the more slender and laxe form with pallid-rufous cap. A yellowish, slender form (*C. scorzonera* Batsch) is also occasionally met with.

### 5. **C. distorta** Fr.

Spores globose, $3^1/_2$—$4 \times 3^1/_4$—$3^1/_2$ μ.

Fig. specim.: »Sønderhav« near Flensborg, gregarious about stump of Picea, Oct. 1900. — Also found in similar locality at Holte (1900) and Aarup (1910).

Although habitually very well characterized this species is not clearly distinguished from the preceding species, the slender form of which forms a connecting link. — The peculiar denticulate marginal veil shown in Fries' figure (Icon. sel. fig. 63[1]) seems to be a licentia pictoria.

(The plant described by Ricken (loc. cit.) under the name *C. prolixa* (Fl. Dan.), with serrulate gills and 3—5 cm broad cap appears to be a form of C. distorta. C. prolixa according to Fries is a much larger plant with entire-edged gills).

6. **C. butyracea** (Bull.).

Spores ovate-lanceolate, $6^1/_2$—$7 \times 3$—$3^3/_4$ μ.

Fig. specim.: Hjallese, wood of Fagus, Okt. 1896. — Very common (often forming »fairy-rings«) as well in beechwoods as in coniferous woods. This species varies very much especially in colour. In woods of Fagus the paler (occasionally almost white) form (fig.) is the predominating type; while the very dark rufofuscous or almost sootbrown form is common in our coniferous woods. This latter type often has the stem (all over or from the base upwards) clad with short, adpressed, pallid hairs. This probably constitutes *Ag. trichopus* Pers.

7. **C. fusipes** (Bull.).

Spores varying from 5—8 μ l., 3—4 μ broad. Cystidia crowded, hairshaped (somewhat wavy), about 2 μ broad. (1911: Spores $5$—$6 \times 3^1/_2$—4 μ).

Fig. specim.: Aarup, fasciculate on and around a stump in wood of Fagus, Oct. 1896. — Also found in »Purreskov« near Hesselager, Aug. 1911, about a living beech.

As shown in my figure the fructifications spring from an ascending, rhizome-like black rhizomorpha. The figured form is most nearly *Ag. oedematopus* Schaeff., while the specimens found in 1911 belonged to a more slender-stemmed, pale form (cap the colour of calfskin) almost answering to the description of *Ag. contortus* Bull. But they are hardly specifically distinct.

β. LÆVIPEDES.

a. *Viscidæ.*

8. **C. velutipes** (Curt.).

Spores: in figured specimens: $9$—$12 \times 2^1/_2$—$4$ μ (uncommonly long); in most cases: $7^1/_2$—$10 \times 3^1/_2$—4 μ, cylindric-ellipsoid. Cystidia conic, rather acute, almost subulate, 8—12 μ broad, protruding part 18—30 μ long. The velvet coating on the stem is made up of long, wavy, about 4 μ broad, yellow-brown hairs.

Fig. specim.: Tarup near Odense, on stump of Fraxinus, Sept. 1895.

Common, often fasciculate, especially on fresh stumps and living trunks of Ulmus, Fraxinus and Populus. Also parasitic on Sambucus racemosus etc. Only once I have met with this species on coniferous wood (a single small specimen on a pole (of Picea)). — Occasionally it is quite dwarfy; I have seen a form, in which the cap was only 14 mm, the whole plant pale yellow.

b. *Siccæ.*

9. **C. dryophila** (Bull.).

Spores $5 \times 3^1/_4$ μ. Cystidia rather inconspicuous, somewhat wavy (and occasionally branched), hairshaped or slightly inflated.

Fig. specim.: Hjallese, on the ground in wood of Fagus, May 1897.

This exceedingly common mushroom, which begins to appear already in spring or early summer, varies very much in colour (from dark date-brown to almost white or very pale ochraceous: (In a wood of Picea (Tommerup 1898) I have even met with a pure white, very small form). Also the gills vary in colour (from pure white to pallid gilvous or even ochraceous).

### 10. **C. macilenta** Fr.

Spores ovate, $4^1/_2$—$5^1/_2 \times 2^1/_2$—$3\,\mu$. Basidia 4-spored. Cystidia hairshaped, somewhat nodulose or wavy.

Fig. specim.: Gerup, near Korinl, on boggy ground in wood of Picea, solitary, July 1900.

### 11. **C. nitellina** Fr. (forma *minor* Fr.).

Spores $7^1/_2 \times 4^1/_4\,\mu$, obliquely ovate, with a somewhat lateral pedicel, granulate-rough. Basidia 4-spored. No cystidia.

Fig. specim.: Langesø, on the ground behind a garden-railing in mixed wood, Sept. 1916 (few specimens).

This little fungus, well figured by Fries (Icones sel. 65 [2]), differs habitually very much from the larger type (Icones sel. 65 [1]). Perhaps it should be regarded as a distinct species, although the spores are similar to those of the large type figured by Ricken (l. cit. tab. 108). — The plant figured by Cooke (l. cit. fig. 146) can hardly be a true C. nitellina.

For comparison I add a brief description of my plant: Cap about 1 cm, flat, umbonate, margin incurved, hygrophanous, dark fulvous. Stem glabrous, lucid, light fulvous, towards the base paler and slightly white-tomentose, somewhat hollow, $3^1/_2$ cm long, $2^1/_2$ mm broad. Gills whitish, with a tinge of ochraceous, rather narrow. It has a faint rancid odour.

### 12. **C. tenacella** (Pers.).

Spores ovate-oval, $5-7 \times 3-4\,\mu$. Cystidia on edge and face of gills cylindric-fusoid, about $10\,\mu$ broad, varying (even on the same gill) from somewhat pointed to almost capitate (contracted a little below the apex, thus forming a kind of head, which often at first is covered with a granulate-warty hood).

Fig. specim.: I »Fruens Bøge«, Nov. 1895; II Vormark, Oct. 1896 (on cones of Picea).

This nice little fungus is common in our woods of Picea on fallen cones, even deeply buried ones, in which case the »root« is long and ascending. The colour of the cap varies from pure white to dark datebrown. The stem, which appears to be glabrous, has a faint bloom. When examined under the microscope this bloom is seen to be, in fact, very scattered, erect, hyaline, very short hairs (about $20\,\mu$ long).

Bresadola (Fungi tridentini, tab. $198^{1-2}$) figures two types, a dark fuscous and a somewhat ochraceous one, which he calls *C. conigena* and *C. esculenta* and takes to be included in the Ag. tenacellus of Persoon (C. conigena in the Friesian sense he evidently does not know). — It seems to me somewhat doubtful whether they can be kept apart. The chief difference appears to be the colour of the cap and the form of the cystidia. But as stated above the form of the cystidia varies even on the same gill. C. conigena sensu Ricken (loc. cit.) is my C. tenacella.

13. **C. confluens** (Pers.).

Spores ellipsoid, base rather pointed, $6^1/_2 \times 3^1/_2$ µ (or $7^1/_2 \times 3^3/_4$). Cystidia hairshaped, somewhat nodulose.

Fig. specim.: Hjallese, in wood of Fagus, on the ground among foliage, Oct. 1896.

Common, as well in woods of Fagus as of Picea, densely fasciculate (often growing in large circles) amongst dead foliage. — It varies very much in colour according to age and atmospheric conditions. When dry it is pale, and when old dry specimens revive in wet weather they become sordidly incarnate or brownish. It forms a transition to *Marasmius*. And like Schroeter (loc. cit.) I do not see any real difference between this plant and *Marasmius argyropus* (»archyropus« auct. div.).

14. **C. conigena** (Pers.).

Spores ellipsoid-ovate, very small, $3 \times 1^3/_4$ µ (or $3^1/_2 \times 1^3/_4$—2). Edge of gills with obtusely fusiform, about 7 µ broad cystidia (the free part of the cystidium is about 25 µ long).

Fig. specim.: Trolleborg, on cones of Pinus, Oct. 1898 (and later years). — Found in several places. Unlike C. tenacella it prefers cones of Pinus. Only once I have met a few specimens growing on a cone of Picea excelsa. Cookes figure (loc. cit. tab. 30) is excellent. See also no: 12. — *Collybia myosurus*, to judge from the descriptions of Fries, Ricken and others, is too closely related to C. conigena to be maintained as a distinct species.

15. **C. tuberosa** (Bull.).

Spores subglobose-ellipsoid, 3—4 × 2—3 µ or 4—5 × $2^3/_4$ (fig. specim.).

Fig. specim.: »Vaasemose«, in mixed wood on the ground amongst sticks and foliage, Oct. 1901. — Rather common, generally growing on dead mushrooms (Lactarius deliciosus, Russula nigricans etc.). The form and colour of the sclerotium most clearly distinguish this species from C. cirrhata.

16. **C. cirrhata** (Schum.)

Spores ovate-ellipsoid, 4—6 × 2—3 µ (or ovate, $4^1/_2 \times 2^3/_4$). Cystidia 0

Fig. specim.: Hjallese, in copsewood on leaf-mouldy ground about an old stump, Oct. 1898. — Very common on and around old stumps, amongst dead foliage and rotten fungi, often gregarious. — If carefully examined the fibrillous »root« can, I believe, always be traced to a sclerotium. (MASSEE (European Fungus Flora) erroneously states that it is devoid of sclerotium.).

17. **C. racemosa** (Pers.).

Spores ovate-ellipsoid, $4^1/_2 \times 2^1/_2$ μ.

Fig. specim.: 1) Hesselagergaard, in deep moss in a ditch in young plantation of Picea, Oct. 1905. 2) Hjallese, on the ground about stump of Populus, gregarious, Sept. 1908. —

The cap is often abortive like the rudimentary heads on the lateral branchlets. Fries in »Hymenom. Europ.« says the gills are white. In my plant they are hoary gray (as described by Quélet (loc. cit.).

18. **C. stipitaria** Fr. (*Ag. caulicinalis* Bull.).

Spores ovate, $8 \times 6$ μ (or oval $6^1/_2 \times 4$ or $9 \times 5$ μ). Cystidia crowded, cylindric-hairshaped, obtuse, about 4 μ broad.

Fig. specim.: Hjallese, on dead tufts of grass (Dactylis), Oct. 1896. — Common, especially on Dactylis, from August to January. I have also seen it growing on rye-stubble (Secale) (Aug. 1900). In this case it must either have attacked the living rye-plant or have developed very quickly in the stubble. —

It is also occasionally met with on dead stems of Syringa (Gudbjærg, January 1900) and on dead twigs of Picea (Vormark, Oct. 1901.).

This tiny little plant is very much like a Marasmius. According to QUÉLET *M. scabellus* (Alb. & Schw.) is identical. But he describes this latter species with »spores sphériques, 12 μ, pointillées«. — *M. epichloë* Fr. also appears to be identic.

## B. TEPHROPHANÆ.

19. **C. rancida** Fr.

Spores ellipsoid, 7—8 $\times 4^1/_2$ μ.

Fig. specim.: Hjallese, wood of Quercus and Corylus, Oct. 1896. Rather common, but solitary, chiefly in deciduous woods, till late in the season. It has a superficial likeness to Mycena polygramma.

20. **C. inolens** Fr.

Spores ellipsoid, 7—8 $\times$ 4—5 μ.

Fig. specim.: Hæsbjerg, somewhat gregarious on the ground in wood of Picea, Oct. 1899. — Not common.

It has a faint mealy smell. My plant corresponds to the umbonate form figured by Fries (Icon. sel. tab. 69[3]). His other form (69[4]) seems to me rather divergent.

21. **C. murina** (Batsch) *var.*

Spores $6^1/_2$—$8 \times 4$—$5\ \mu$.

Fig. specimens: Aarup, mixed coniferous-foliaceous wood, Oct. 1896. — This species is met with occasionally especially in foliaceous woods, somewhat gregarious. It has a very slight mealy smell. — My plant differs from the Friesian description by not becoming umbilicate.

22. **C. clusilis** Schroet. (Fr.?).

Spores ovate, $6$—$7 \times 4^1/_2\ \mu$. Basidia 4-spored. Cystidia 0.

Fig. specim.: »Sortsø«, in wood at Gerup near Holstenshus, on Sphagnum, July 1910. — Also found (on Sphagnum) in other localities of the some district, July—Aug. 1914.

This little Collybia, which reminds one of an Omphalia, is very well described by Schroeter (loc. cit.). *C. obstans* Britz. appears to be identical. It has a very faint somewhat mealy smell.

C. clusilis seems to be very differently conceived by the leading mycologists. Probably the form B., mentioned by Fries as growing »in pratis post largas pluvias, inter Hypna«, is my plant, although his description does not fit very well. The plant described by Quélet (Flore mycol.) as growing in woods and on sandy heaths can hardly be identical. Cooke's figure is not like my plant, and »C. clusilis« of Karsten has larger spores ($7$—$9 \times 5$—$6\ \mu$).

23. **C. miser** Fr. *var.*

Spores ellipsoid, $7^1/_2 \times 3^1/_2\ \mu$. Cystidia 0.

Fig. specim.: Stenløse, on the ground in shady wood of Corylus and Fagus, Sept. 1905 (and 1916).

My plant agrees fairly well with the figure (Icon. sel. 70[4]) and description of Fries, but grows in foliaceous woods, and the gills are not exactly »cinereæ« but rather pallid-sordid. The apex of the stem is slightly pruinose. Karsten (loc. cit. pag. 106) describes the spores as being 7 μ long, minutely prickly (»fintaggiga«).

24. **C. ozes** Fr. *var.* (?) Plate III fig. 2.

Spores ovate $4^1/_2$—$5 \times 3\ \mu$. Basidia 4-spored. Cystidia 0.

Fig. specim.: Aarup, gregarious on the ground amongst dead needles in wood of Picea, Aug. 1915. — Also found in same locality 1916, and at Kirkeby, in wood of Picea, Oct. 1915 (a pale form).

As my plant diverges somewhat from the description of Fries I add a short diagnosis: Cap about 2 cm, hygrophanous, even

at first convex, then flat or slightly depressed, brownish fuscous (when dry pale sordid or almost clay-coloured). Stem hollow, often somewhat rooting, dark fuscous, everywhere with white silky fibrils, base white-tomentose, 4 cm × 5 mm. Gills sordid, paler towards the edge, crowded. Rancid odour not very strong.

It differs from *Clitocybe ditopoda* by the rounded-adnate gills and the ovate spores. My plant appears to be the same as described by Sev. Petersen (loc. cit.).

### 25. **C. mephitica** Fr.

Spores oval, $3^1/_2$—4 × $2^1/_2$ μ. Basidia 4-spored. Cystidia 0.

Fig. specim.: Ravnholt, gregarious on the ground in wood of Picea, Oct. 1902. — This tiny little mushroom is well characterized by its disagreeable smell and by the dark sordid-gray gills, which are darker than the cap.

### 26. **C. cessans** Karst.

Spores ovate-globose, $5^1/_2$—6 × $4^1/_2$—5 μ. Basidia 4-spored. Cystidia on edge cylindric-hairshaped. (1914: Cystidia 60—65 × 10—12 μ, slightly swelled in the middle).

Fig. specim.: »Fruens Bøge«, gregarious in wood of Abies, Oct. 1903. — Also found in several other places 1904—14.

Karsten's description fits my plant very well. Fries (in Epicrisis pag. 92) describes C. cessans as a variety of *C. stolonifera* (= tenacella var.), what my plant certainly is not. — Except for the not decurrent (but horizontal, slightly ventricose, adnate) gills and the very short stem this species is very near to *Omphalia striæpilea* Fr. (nec Quélet), perhaps not really distinct. — Sev. Petersen and Saccardo describe the spores: 7—9 × 5—6 μ, much larger than in Karsten's plant (loc. cit. p. 107).

### 27 a. **C. erosa** Fr.

Spores subrotund-oval, almost spinulose, 7 × $5^1/_2$ μ. Cystidia 0. (1909 and -14).

Fig. specim.: Aalsbo, border of walk in wood of Picea, 1909. — Also at Rudme 1914.

### 27 b. **C. e.** forma *gracilis*.

Spores $5^1/_2$—$7^1/_2$ × $5^1/_2$ μ, nodulose-stellate. Basidia 4-spored.

Fig. specim.: Aarup, mossy ground in Picea-plantation, solitary, Oct. 1904. A slender form, almost like a small Mycena. Cap convex, with a small wart-like umbo, dingy brownish, 0,5 cm broad. Stem 3 cm × 0,6 mm, of the same colour. Gills rather broad, somewhat adnate.

Quélet (loc. cit.) describes the spores of C. erosa »ovoide-pruniforme« 6—7 μ, but does not mention their warty epispore.

28. **C. tesquorum** Fr.

Spores subrotund-oval, $7 \times 5^1/_2$ μ, minutely warty-spinulose (like a Russula-spore). Basidia 4-spored Cystidia 0.

Fig. specim.: Between Tommerup and Hæsbjerg, on somewhat peaty ground in meadow outside a beechwood, Oct. 1901.

My plant is more short-stemmed and more evidently umbonate than Fries' figure. It seems to be very nearly allied to *C. tylicolor*, which, according to Quélet, has similar spores but is more ashy-gray. In my specimens the cap is dark fuscous, 1 – 2 cm broad, almost even, submembraneous; the gills broad, rather distant, strongly emarginate, almost free, and the stem short (2 cm), fuscous, apex slightly white-plumulose.

For figures of spores etc. of the several species vide plate I.

# THE GENUS INOCYBE.

While FRIES (in »Hymenomycetes Europæi«) only describes 45 species of Inocybe (as here understood), the number mentioned in BATAILLE's »Flore analytique des Inocybes d'Europe« is about 100. This extraordinary increase (from 1870—1910) is partly explained by the fact, that just about the time of publication of »H. E.« the use of the microscope was introduced in this field of mycology. And one of the first results of this was that a good many species of Inocybe, which hitherto it had been almost inpossible to distinguish, were easily recognised by their different type of spore: smooth or nodulose-stellate.

But the discovery of this reliable and practical means of identification made great havoc to the whole system of classification. In cases where an old polymeric species was seen really to comprise 2 or 3 distinct ones, it was almost impossible to make out which of these new species could rightly claim the old name. Thus in later works we find the old names *I. scabella*, *I. carpta*, *I. fastigiata*, *I. hiulca* etc. attached to as well smooth-spored as roughspored species in a most bewildering way. — When later on the characteristic difference of the cystidia was also introduced in the diagnoses as a new and valuable means to distinguish species which have a superficial likeness to each other, this new step in advance in many cases increased the confusion in such a way, that now one almost feels inclined to throw the table over end and start afresh with entirely new names for all the species that can be distinguished by the means now available.

This however is out of the question; but occasionally — f. inst. in the case of »*I. rimosa*« — I deem it advisable entirely to drop the old name; because it evidently was not a specific but a collective name, embracing several common species. »I. rimosa« of the ancient authors to my mind includes *I. brunnea*, *I. Cookei*,

*I. sabrimosa*, *I. asterospora* etc., all very common species which were not then recognised as such. »Type-specimens«, by means of which the priority-right to an old name could be ascertained, as a rule do not exist; and the »type-figures« may be interpreted to represent anything or nothing.

Classification. After the discovery of the characteristic differences in the shape of the spores, the splitting up of the genus Inocybe by creating a new genus (*Clypeus* (Karsten), *Astrosporina* (Schroeter)) to embrace all the rough-spored species, was soon proposed. But it appears to me hardly the right thing to do. Inocybe in the old sense is a very »natural« genus: one almost at a glance recognises an Inocybe. And to disband such a natural entity I cannot consider an improvement.

But of course the characteristic microscopic differences must needs be accorded a prominent place in any classification propounded. And consequently a rational systematic classification cannot entirely follow the lines laid down by Fries. This eminent mycologist, it will be remembered, divided the genus in several series, chiefly characterized by the nature of the surface of the cap. But although these characters are evidently very valuable for purposes of classification, they lack a good deal in preciseness, and moreover are greatly influenced by the age of the specimens and the atmospheric conditions. Not so the microscopic characteristics. I therefore accord to these the more prominent place.

Of the microscopic characteristics the shape of the spore is the one most easily ascertained and most marked. We thus get two main tribes or subgenera, the smooth-spored *(Eu-Inocybe)* and the rough-spored *(Clypeus)*. But this latter tribe again includes two different types: In most of the rough-spored species the spore is substellate or nodulose, but in some few small ones the spore is subglobose or broadly oval, set with long, acute or somewhat obtuse spinelets.

The cystidia come next in importance for purposes of classification. Cystidia of some kind or other are never wanting in the Inocybes. But while a good many, especially of the smooth-spored species — have cystidia of a rather trivial kind (inflated clubshaped or the like, almost like overgrown sterile basidia) the rest have cystidia of a kind particular to this genus: fusoid-ventricose or almost bottleshaped with a crest of small cristalloid muriculate bodies. In some species both kinds occur

together, but in such cases those on the face of the gill are always of the crested type, while the edge is provided with both kinds, occasionally with intermediate forms. The trivial kind never occurs on the face of the gill. Some authors, f. inst. MASSEE and BATAILLE, reserve the name cystidia for the muriculate type only, and consequently divide the species in cystidiate and cystideless series.

When we come to the minor subdivisions the old Fries'ian characters must be taken into consideration. But of the 5 tribes established by him the last and smallest (*viscidi*) is broken up by removing *Agaricus Tricholoma* and its allies from the genus altogether (as is now generally done); and the remaining species — which are however unknown to me — probably better can be placed within one group or other of the remaining 4, as they naturally fall in with the subviscid species of these (f. inst. *I. umbrina* and *I. prætervisa*). With regard to the remaining Fries'ian tribes I think the line of demarcation between *squarrosi* and *laceri* is rather vague; and the same may be said of *rimosi-velutini*. I therefore deem it more practical to unite 1 & 2 and 3 & 4 respectively.

Although the smell of most fungi is very characteristic and constant, it is of small value for classification-purposes, as it is too difficult to define. Very few, if any, of the Inocybes are entirely inodorous, most of them have a faint but disagreeable »earthy« or spermatic smell. But the strong aromatic smell of *I. pyriodora* and several other species — generally compared to the smell of *Calycanthus*-flowers or over-ripe pears — is so unmistakable that it can be profitably used for characterizing this little group of closely related species.

The minor details of my classification can be seen in the Key and will require no particular explanation.

From the adjoining genera Inocybe is generally well distinguished. Some modern authors (SCHROETER, SEV. PETERSEN a. o.) transfer the indusiate species of *Hebeloma* to Inocybe, but this can hardly be considered a real improvement. The indusiate and the veil-less Hebelomas are so intimately related in all other respects (also with regard to their microscopic characteristics) that I think it absolutely preferable to maintain the old Fries'ian line of demarcation. To separate f. inst. *H. longicaudum* and *H. testaceum*, *H. crustuliniforme* and *H. fastibile* cannot be done without ignoring true relationship. Besides, if veil or no veil is

to be the only and decisive test, some of the Inocybes — which have practically no velum partiale — would have to go too, and the whole would end in utter confusion. — The little elegant *A. petiginosus* in later years was referred by Fries to Hebeloma, although he had formerly recognised it as an Inocybe. Its nodulose spores naturally take it back to Inocybe (as done by almost all modern authors).

Some of the very smallest species, f. inst. *I. calospora*, have a habitual likeness to *Naucoria*. In fact, according to Quélet, two of the species which Fries placed within the genus Naucoria (*N. pannosa* and *N. sublimbata*) have stellate or spinulose spores and should be transferred to Inocybe (Clypeus); (vide Bataille »Flore analytique« pag. 22). — *Flammula* also comprises a few species (from the tribe *sericelli*) which connect this genus with Inocybe. This is especially true of what I call *F. Agardhii* (Lund), which is, I believe, identic with *Inocybe xanthica* (von Post) (L. Romell in lit). Also *Inocybe delecta* Karst. has much in common with the Flammula sericelli. — The *Cortinarii* will very rarely be confounded with the Inocybes by the trained mycologist.

The number of species found and figured by me is 47, that is to say as many as Fries had on record from the whole of Europe, and one third more than he had seen alive. Still I do not doubt my number is too small. No year has passed during my 24 years of investigation in this line without adding to the number of species found. And other mycologists have met with species which I have not seen and which seem to be distinct from any of mine. Thus among the 33 species mentioned by Sev. Petersen (loc. cit.) is *I. mutica*, which appears to be a very well defined species. On the other hand some of the »species« figured by me are so intimately related, that it is somewhat doubtful whether they deserve a specific name. Still I think it better provisionally to uphold the existing names than to unite too many forms under one specific name, as long as their whole nature is not more precisely known. Coming mycologists will have to settle such questions, when the whole field is more thoroughly investigated.

# KEY

## TO THE SPECIES FIGURED OF THE GENUS INOCYBE.

### I. EU-INOCYBE (P. Hennings).

spores smooth, generally ovate or phaseoliform.

A. **Muriculatæ**. Cystidia (or at least some of the c.) subfusoid or ventricose, often crested with cristalloid muriculate bodies.

α. Pyriodoræ. The whole plant has a strong sweetish-aromatic smell (almost like Calycanthus-flowers).

a. Cap whitish or brownish ochraceous.

1. Cap rather obtuse, fibrillose (or subsquamose), more or less ochraceous.

* Large and stout. The stem (and occasionally also the cap) becomes flushed with bright incarnate . *I. incarnata* (1)

** Somewhat smaller, Stem never bright incarnate (only the flesh slightly so, especially in the stem) . . . *I pyriodora* (2)

2. Umbo acute; cap whitish, then pale clay-colour. . . *I. albidula* (3)

b. Cap obtuse, with bistre or dark brown adpressed scales *I. scabra* (4)

β. Ingratæ. Smell wanting or faint, disagreeable (»earthy« or spermatic.

a. squarrosæ-laceræ. Cap squarrose or tomentose-squamulose.

1. Stem with squarrose scales . . . . . . . . . . . . . . . . . *I. Hystrix* (5)

2. Stem flocculose-fibrillose.

* Spores almost cylindric, long. Flesh brownish . . . . *I. lacera* (6)

** Spores subovate or phaceoliform.

† Cystidia on edge brown. Surface of cap dark brown, (apex of stem at first often bluish).

o Cap small ($1^1/_2$ cm), set with erect minute scales. . . . . . . . . . . . . . . . . . . . . . . *I. cincinnata* (7)

oo Cap larger (2—3 cm), tomentoso-squamulose *I. obscura* (8)

†† Cystidia hyaline. Cap pale or grayish brown.

o Stem pale lilac . . . . . . . . . . . . . . *I. griseo-lilacina* (9)

oo Stem pallid or somewhat brownish.

§ Cap small ($1^1/_2$ cm), clad with whitish fibrils and fibrillose scales . . . . . . . . . . . . . *I. abjecta* (10)

§§ Cap larger ($2—3^1/_2$ cm), dull brown (grayish or subfulvous), tomentose and fibrilloso-squamulose . . . . . . . . . . . . . . . . . *I. flocculosa* (11)

b. rimosæ-velutinæ. Cap fibrillose, when expanding either rimose or almost smooth, sometimes slightly innato-squamulose

1. Spores medium-sized, over 8 μ long.

* Apex of stem at first violet or bluish.

† Cap brown, somewhat rimose . . . . . . . . . . . . *I. pusio* (12)

†† Cap lilac (becoming pale) silky-fibrillose. . . . *I. geophylla* (13

**Stem not bluish.

† Cap whitish when young.

° Cap small (2 cm), acute.

§ Cap becoming pallid with age. *I. geophylla v. alba* (13 b)

§§ Cap soon flushed with tile-red or light red . . . . . . . . . . . . . . . . *I. geophylla lateritia* (13 c)

°° Cap larger (3–5 cm), rather obtuse.

§ Cap (and other parts) soon more or less flushed with incarnate: stem without striæ . . . . . . . . . . . . . . . . . . . . . . *I. rubescens* (14)

§§ Cap becoming pale clay-white; stem minutely striate . . . . . . . . . . . . . . . . *I. sindonia* (15)

†† Cap brownish or ochraceous.

° Cap ochraceous or pale dingy brown.

§ Cap pale dingy brownish, soon more or less diffracto-squamose; stem minutely-striate . . . . . . . . . . . . . . . . . *I. deglubens var.* (16)

§§ Cap ochraceous.

› Cap more or less squamulose; young stem pruinose.

( Cap medium-sized (2—4 cm); stem whitish . . . . . . . . . . . . . . . . . *I. cæsariata* (17)

(( Cap small (1—2 cm); stem yellowish. *I. hirtella* (18)

» Cap more or less rimose (not squamulose); stem not pruinose.

( Cap medium-sized (3—5 cm) . . . . *I. posterula* (19)

(( Cap small, about $1^1/_2$ cm . . . . . *I. auricoma* (20)

°° Cap rather dark brown; stem without striæ.

§ Cap medium-sized (2—4 cm); stem and edge of cap fibrillose . . . . . . . . . . . . . . *I. pallidipes* (21)

§§ Cap small (1—2 cm); stem not fibrillose *I. descissa* (22)

2. Spores small (6–7 μ long); cap smooth, brownish, $1—1^1/_3$ cm . . . . . . . . . . . . . . . . . . . . . . . . . . *I. microspora* (23)

B. **Depauperatæ**. Cystidia not crested, clubshaped or basidiiform (only found on the edge of the gills).

α. Pyriodoræ. Smell strong, sweetish-aromatic.

Cap fibrillose, somewhat squamulose; flesh turning pink. *I. Bongardii* (24) (vide also no. 3.)

β. Ingratæ. Smell wanting or faint, disagreeable.

a. squarrosæ-laceræ. Cap squarrose or tomentose-squamulose.

1. Cap and stem squarrose, dark brown . . . . . . *I. calamistrata* (25)
2. Cap velvety-squamulose, fulvo-ochraceous; stem fibrillose. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . *I. delecta* (26)

b. rimosæ-velutinæ. Cap rimose or almost smooth, sometimes with adpressed, fibrillose scales).

1. Stem with a submarginate bulb; cap ochraceous. . . *I. Cookei* (27)

2. Stem without distinct bulb, almost equal.
   * Flesh not turning red or incarnate.
     † Cap subfulvous-ochraceous, central part with adpressed fibrillose scales . . . . . . . . . . . . . . . *I. squamata* (28
     †† Cap without scales, subrimose or fibrillose.
       ° Cap ochraceous, distinctly rimose; gills at first pale yellowish . . . . . . . . . . . . . . . . . . . *I. fastigiata* (29
       °° Gills at first pallid.
         § Cap not distinctly rimose very large, with dark umbo, paler towards the edge) . . . . *I. perlata* (30
         §§ Cap distinctly rimose, deep brown . . . . *I. brunnea* (31
   ** Flesh turning purplish-red or pale incarnate.
     † Cap rather large, with dark violet-fuscous fibrils. Flesh turning purplish-red . . . . . . . . . . . . . *I. jurana* (32)
     †† More slender. Cap pallid-ochraceous. Stem when cut or bruised turning pale rosy . . . . . . . . *I. rhodiola* (33

## II. CLYPEUS (Karsten).

Spores spinulose, stellate or nodulose.

A. **Calosporæ.** Spores subrotund, spinulose.
Cap somewhat scaly, $1^1/_2$—2 cm . . . . . . . . . . . . . . . . *I. calospora* (34

B. **Astrosporinæ.** Spores stellate or nodulose-angular.
  α. Muriculatæ. Cystidia (or at least some of them) subfusiform, apex generally crested with muriculate bodies.
    a. Spores almost stellate (with conical, blunt or rather acute projections).
      1. Stem with a marginate bulb, pruinose.
        * Cap strongly rimose with dark brown fibrils. Stem minutely striate, pruinose, becoming brown. . *I. asterospora* (35
        ** Cap ochraceous, subrimose. Stem whitish-ochraceous. . . . . . . . . . . . . . . . . . . . . . . . . . . *I. prætervisa* (36
      2. Stem almost equal, subglabrous, white; cap pallid or somewhat clay-brownish, fibrillose. . . . . . . . . . . *I. fibrosa* (37
    b. Spores nodulose.
      1. Spores rather large (over 8 μ long).
        * Stem bulbous.
          † Cap not rimose, dingy; cuticle formed of whitish silky fibrils . . . . . . . . . . . . . . . . . . . . . . *I. grammata* (38
          †† Cap somewhat rimose, brown.
            ° Cap not viscid, rather acute.
              § Rather large (cap 3—5 cm) . . . . . . . . . *I. napipes* (39
              §§ Cap small (2 cm) . . . . . . . . . . . . . *I. umboninota* (40)
            °° Cap subviscid, rather obtuse . . . . . . . . . . *I. umbrina* (41)
        ** Stem almost equal.
          † Cap large, dark brown, tomentose and somewhat squamulose. . , . . . . . . . . . . . . . . . . . . . . . *I. plumosa* (42)
          (Cap pallid or argillaceous: vide no: 37.

†† Cap smaller (1—3 cm).

° Cap fibrillose-tomentose, grayish-brown, $1^1/_2$—3 cm . . . . . . . . . . . . . . . . . . . . . . . *I. lanuginella* (43)

°° Cap subrimose, brown, small (1 cm) . . . . . . *I. putilla* (44)

2. Spores small (7—8 μ long). Young cap covered with whitish squamules or fibrillose scales, small (1—2 cm).

* Subfasciculate; stem not everywhere pruinate (only slightly flocculose) . . . . . . . . . . . . . . . . . . . . *I. rufo-alba* (45)

** Solitary. Stem brown, everywhere pruinate . . *I. petiginosa* (46)

β. depauperatæ. Cystidia not crested, obtuse, inflated club-shaped or somewhat ventricose).

Cap dark brown, tomentoso-squamose. Stem flocculose, brownish . . . . . . . . . . . . . . . . . . . . . . . . . . . *I. lanuginosa* (47)

## SYSTEMATIC AND FLORISTIC NOTES.

As many of the Inocybes can only be distinguished by minute details which it is often almost impossible to depict with sufficient exactness, I think it not superfluous to give more detailed notes on their macroscopic characteristics than usual in these studies.

Spores etc. of all the species are figured on plate II.

## I. EU-INOCYBE.

### A. MURICULATÆ.

#### α. PYRIODORÆ.

1. **Inocybe incarnata Bres.** (= *I pyriodora var.*).

Spores broadly ovate, $6^1/_2$—10 × $3^1/_2$—6 μ. Cystidia inflated bottle-shaped, about 12—18 μ broad, muriculate.

Figured specimens: Marselisborg near Aarhus, under young beeches, moist ground in wood, Oct. 1916 (leg. Poul Larsen). Rare.

Very nearly related to the ordinary I. pyriodora, but more robust (stem over 1 cm). The cap is at first almost smooth, pallid-ochraceous or whitish clay colour, then somewhat fibrillose-subsquamulose, ochraceous-brownish, somewhat flushed with

incarnate. The stem is at first white, then (except base and apex) tinged deep and rich incarnate or pinkish. Flesh of stem incarnate, of cap paler.

2. **I. pyriodora** (Pers.).

Not figured.

The typical or intermediate form of the pyriodora-group (well figured by Bresadola (loc. cit. tab. 52) is not very common with us, but met with occasionally in foliaceous woods. The cap is somewhat ochraceous, scaly-fibrillose. The flesh is often almost without a tinge of incarnate. Such specimens, especially if the umbo is somewhat conic and the cap without scales, form a transition to *I. albidula* (no. 3).

3. **I. albidula** Britz. ex Sacc. (?). Plate III, fig. 3.

Spores obliquely ovate, $9 \times 5^1/_2$ μ. Cystidia on edge of two kinds: a) inflated-fusoid, 13—16 μ broad, muriculate; b) inflated-clubshaped or roundish, 10—15 μ broad.

Fig. specim.: Hunderup, wood of Fagus, Aug. 1915. Not rare, in foliaceous woods. Typical specimens are easily distinguished from the preceding species by the following characteristics: Cap at first conic-campanulate, rather acute, then expanded with prominent umbo. Surface at first whitish, smooth (slightly viscid), later on — especially towards the edge — argillaceous and somewhat fibrillose. Stem comparatively short, firm, equal or slightly bulbous, almost glabrous, at last slightly brownish-fibrillose. Gills at first pallid. Flesh almost white, in base of stem and umbo occasionally turning faintly incarnate, as does also the stem when bruised. The descriptions of Saccardo and Bataille do not exactly cover my plant, but I have found no others which will fit it. Probably most mycologists have not separated it from *I. pyriodora*.

[*I. corydalina* Quél. — It is not rare to meet with specimens of I. albidula in which the umbo — rarely the whole surface of the cap — is as if stained with glaucous-gray ink. This I believe is *I. corydalina* Quél. (said to smell like Corydalis cava (bulb?)].

4. **I. scabra** Ricken (nec al.).

Spores somewhat oblique, ovate, $9 \times 5$ μ. Cystidia on edge: a) cylindric-bottleshaped, slightly muriculate, about 10 μ broad; b) cylindric-clubshaped, about 7 μ broad.

Fig. specim.: Hollufgaard, moist foliaceous wood, Aug. 1915. Rather rare. This species is also very close to I. pyriodora. Its chief distinctions are: Cap obtusely umbonate or gibbous, central part covered with dark umber (or almost bistre) broad, adpressed scales, towards the edge fibrillose-lacerate and somewhat paler. Stem whitish, towards the base somewhat sordid. Gills

at first white, then grayist sordid, emarginate with a decurrent line. Flesh whitish, that of the stem turning slightly dirt-brown, but not flushed with incarnate.

The synonymy of this species is very bewildering. I have selected the name *I. scabra* sensu Ricken (loc. cit. pag. 108), but omitted the name Müller (or Flora Danica). What *Ag. scaber* Müller really is, nobody is likely ever to find out. — Probably the plant mentioned by Massee (Monograph pag. 489) and figured by Cooke (loc. cit. tab. 381) sub nom. *I. Bongardii* is identic. The *I. scabra* of Fries, Massee, Quélet and others is without smell, and the *I. scabra* figured by Cooke is very unlike my plant.

### β. INGRATÆ.

#### a. squarrosæ-laceræ.

5. **I. Hystrix** Fr. (forma *minorem* Fr.).

Spores narrowly ovate-lemonshaped, 10 × 6 μ. Edge of gills sparingly set with dispersed, fusoid-bottleshaped, slightly muriculate, about 14 μ broad cystidia, mixed with numerous inflated ovate, about 12 μ broad ones. The erect cuspidate scales on the cap are formed of agglutinate fibrils.

Fig. specim.: Vaasemose, wood of Fagus, Oct. 1915 (a single specimen).

Excellently figured by Fries (Icones sel. tab. 106 [1]), but my plant was smaller and not so dark.

6 a. **I. lacera** Fr.

Spores almost cylindric, long, 11—15 × $4^1/_2$ μ (or 11—18 × 5—$5^1/_2$, 10—13 × $5^3/_4$ μ). Cystidia (projecting portion) inflated conic, obtuse or somewhat acute, occasionally slightly muriculate, about 18 μ broad.

Fig. specim.: Bederslev, edge of path in young plantation of Picea, July 1898. — Common on sandy ground, especially in plantations of Picea etc., but also in the sandhills along the West-coast. — (*I. maritima* is said to have nodulose spores, but seems to be very much like this species).

6 b. **I. lacera** forma *gracilis*.

Spores and cystidia as in the type.

Fig. specim.: Hjallese, in copsewood amongst grass (on rather rich soil), Sept. 1904. Slender like a *Leptonia*, but probably only a somewhat etiolated form.

7. **I. cincinnata** Fr.

Spores obliquely ovate, 9 × 5 μ. Cystidia on edge: a) dispersed, projecting, cylindric-elongated fusiform, slightly muriculate;

b) numerous, inflated, roundish. On the face of the gills are numerous cystidia of the former kind. Contents of cystidia brownish.

Fig. specim.: Hjallese, moist foliaceous copsewood, Aug. 1902. Common in similar localities.

In the young plant the upper portion of the stem is (inside and outside) violet-blue The edge of the gills is brown (from the cystidia), the sides pallid (but not bluish). Figured very well by BRESADOLA (loc. cit. tab. 51 [2]). The plant figured by COOKE (l. c. tab. 425), with nodulose spores, does not belong here.

8. **I. obscura** (Pers.).

Spores obliquely ovate (narrower towards apex), $7^1/_2$—$9 \times 4^1/_2$—$5\ \mu$. Cystidia brown, inflated, of variable shape.

Fig. specim.: Bederslev Dale, in wood of Picea, aggregate, July 1898. — Not rare in similar localities.

This species differs from the preceding one in being larger (cap 2—3 cm) and more robust. The surface is tomentose-squamulose, disc subsquarrose but not set with erect, pointed squamules like I. cincinnata. The flesh is whitish (in apex of stem occasionally slightly flushed with violet) tasteless and with a faint disagreeable smell. The cap is fuscous-umber, never violet. For this and other reasons I formerly referred this plant to *I. dulcamara* forma *æstivalis*, with the description of which (by Fries) it fairly well agrees. But as *Ag. dulcamarus* Alb. & Schw. — whatever that name was originally intended to represent — is now generally used for a plant very different from mine, I follow most modern authors in using the name I. obscura.

9. **I. griseo-lilacina** n. sp. (Plate III, fig. 4).

Spores somewhat obliquely ovate-ellipsoid, $9 \times 5\ \mu$. Cystidia inflated, of variable shape (hyaline).

Fig. specim.: Stensballe near Horsens, growing gregariously on leafmouldy ground in wood of Fagus, Aug. 1909. Found several times in similar localities in Fyn (1910—16).

*Pileo 2 cm lato, pallide brunneo, margine griseo-lilacino, primitus tomentoso, dein lacerato-squamuloso, marginem versus fibrilloso et sub-fimbriato. Stipite 4—7 cm × 3 mm, farcto, intus extusque pallide lilacino, albido-flocculoso-fibrilloso. Lamellis latiusculis, subadnatis vel adfixis, pallide fusco-brunneis (primitus albido-lilacinis), acie alba. Sporæ et cystidia ut supr.*

It seems to be closely related to *I. violascens* Quél. The pale lilac colour distinguishes it from no. 10.

10. **I. abjecta** Karst.

Spores ovate, $8^1/_2$—$9^1/_2 \times 4^1/_2\ \mu$. Cystidia bottleshaped-fusoid, 12—13 $\mu$ broad, apex muriculate.

Fig. specim.: Langesø, on black soil, edge of pond in folia-

ceous wood (Fagus and Tilia), Sept. 1916. — Also found in other localities, in mixed foliaceous woods.

Subfasciculate. Cap 1—2 cm, slightly umbonate, main colour at first hidden by the whitish, fibrillose-subflocculose tomentum, which in the central part soon disappears, thus revealing the brownish colour. Stem somewhat wavy, thin (2—3 mm), 3—4 cm high, inside and outside pallid incarnate-brownish, at first everywhere white-plumulose-fibrillose.

11. **I. flocculosa** (sensu Mass.).

Spores obliquely ovate, 9—$9^1/_2 \times 5$ μ. Cystidia narrowly fusoid, 12 μ broad, muriculate; (on the edge also some few obovate-club-shaped ones).

Fig specim.: Højsholt near Tommerup, wood of Fagus and Quercus, Sept. 1916.

Cap 2—$3^1/_2$ cm, campanulate-convex, then expanded gibbous, of a dull brown colour, at last somewhat lighter (subfulvous), everywhere fibrillose-tomentose-subsquamulose; towards the edge the fibrils are somewhat hoary-gray and at last slightly rimose. Veil well developed, fibrillose. Stem about 5 mm broad. For the rest not much different from no. 10. Vide also no. 21.

b. rimosæ-velutinæ.

12. **I. pusio** Karst. Plate III, fig. 5.

Spores $9^1/_2$—$10 \times 4^3/_4$—5 μ. Cystidia 13—19 μ broad, fusoid-bottle-shaped, muriculate.

Fig. specim.: Hollufgaard, wood of Quercus and Corylus, on moist ground, Sept. 1916.

Corresponds exactly to the description given by Karsten. (Kritisk öfversigt af Finlands Basidsvampar, p. 465.) The apex of the stem is very slightly white-flocculose. Well characterized by the brown, subrimose cap and lilac apex of stem. Affined to *I. descissa*.

13 a. **I. geophylla** (Sow.).

Spores obliquely ovate-ellipsoid or ovate, 8—$9 \times 4$—6 μ. Cystidia dispersed, fusoid-bottleshaped, rather long, apex muriculate. Apex of stem clad with hyphæ and cystidia af the same shape as those on edge of gills (1916).

Fig. specim.: Hjallese, foliaceous copsewood, Oct. 1895. — Common in similar localities.

13 b. **I. g.** var. **alba** (= *A. albus* Schw.).

Spores and Cystidia like no. 13 a. — The white — when old somewhat pallid — cap apparently is the only characteristic distinguishing this form from the lilac one. — It is common

— often very numerous — also in coniferous woods, where the lilac form is comparatively rare.

### 13 c. I. g. var. **lateritia** (Weinm.).

Spores 7—8 × 5 μ, somewhat obliquely ovate. Cystidia 16—20 μ broad, ventricose-bottleshaped, rather obtuse, apex with or without small warty excrescences.

Fig. specim.: Glamsbjerg, gregarious on the ground in wood of Picea, Aug. 1900.

When in bud this variety is white like no. 13 b, and some specimens remain so; but most specimens soon become tinged, all over or partly, with a bright tile-red.

### 14. I. **rubescens** Gill. (= *I. Godeyi Gill.*).

Spores obliquely ovate, 9—9½ × 5 μ. Cystidia broad, inflated, obtuse or ventricose-bottleshaped and muriculate.

Fig. specim.: Lemvig, under shrubs in park, Oct. 1908; gregarious. To be met with occasionally as well in foliaceous as in coniferous woods.

Distinguished from 13 c by the obtusely-umbonate cap, larger size (stem up to 1 cm broad) etc. The smell is faint, spermatic. Every part of the plant turns more or less incarnate-rubescent when old or bruised.

Bresadola (loc. cit.) refers this characteristic species to *Ag. Trinii*, Weinm.; but Massee (loc. cit., page 470) conclusively proves this to be an error. All modern authors agree that *I. rubescens* and *I. Godeyi* are synonyms.

### 15. I. **sindonia** Fr.

Spores obliquely ovate, 8—10½ × 4½—5 μ. Cystidia on edge: a) fusoid-bottleshaped, muriculate, 10—12 μ broad, b) small, ovate-clubshaped, 25 × 10 μ.

Fig specim.: Vaasemose, edge of plantation of Abies, Oct. 1913. — Found in diverse localities, always in coniferous woods.

Intermediate between the white I. geophyila and no. 16. Microscopically it is absolutely like the latter, and probably it is only a variety of this species.

Cap 3—4 cm, campanulate-convex, soon expanded-umbonate, at first whitish, smooth, then sordidly whitish with a tinge of ochre or pale clay-colour, minutely fibrillose-tomentose, at last somewhat fibrillose-rimose. Stem rather long, slender, smooth, minutely striate, apex powdered, occasionally slightly hollow, whitish, apex at last slightly brownish. Veil apparent but fugacious. Gills free, crowded, at first whitish, then light grayish-brown with a whitish edge.

16 I. **deglubens** Fr.

Spores obliquely ovate, 9 × 5 μ. Cystidia on edge: a) bladder-shaped, short, 10—14 μ broad, b) fusoid, protruding, muriculate.

Fig. specim.: Hesselager (»Skelmose«), in wood of Abies, Oct. 1906 — and in several other coniferous woods, generally gregarious.

Cap at first innately fibrillose-tomentose, then more or less cracked-squamulose, dingy brownish, at last darker, almost date-brown. Stem pallid, with a tinge of brownish, apex somewhat white-plumulose or powdered, minutely downy-fibrillose towards the base. — My plant is never »obscure furfurata« on top of stem, and probably comes nearest to Karsten's var. *trivialis*.

17. **I. cæsariata** Fr. *var.*

Spores 7—8 × $4^1/_2$—5 μ, ovate or ellipsoid. Cystidia scattered, their protruding part cylindric-bottleshaped, muriculate or not.

Fig. specim.: Hjallese, on moist ground (Spiræa Ulmaria etc.) in foliaceous wood, Aug. 1904. Also found in some other similar localities.

Cap somewhat convex, umbonate, then expanded-umbonate, covered (except about the umbo) with brownish-yellow fibrils, which at last form small fibrillose squamules. Stem at first minutely powdered, then smooth, slightly striate. Gills at first whitish, then dingy brownish with a tinge of yellow. — Perhaps too closely related to *I. hirtella*. — Cooke's figure shows an almost chestnut-brown, scaly fungus, very different from mine.

18. **I. hirtella** Bres.

Spores ovate, $9^1/_2$ × 5 μ. Cystidia on edge: a) bottleshaped, muriculate, b) inflated, obtuse.

Fig. specim.: Fruens Bøge in grass on roadside in foliaceous wood, Aug. 1907. Also found in other similar localities, especially under Corylus.

Cap $1^1/_4$ × 2 cm, somewhat conic, at last expanded and slightly umbonate, towards the edge fibrillose and at last slightly rimose, but for the rest set with small fibrillose squamules, central part brownish-yellow, edge paler. Stem minutely striate-sulcate, velvety-pruinose (i. e. clad with cystidia like those on the gills), pallid ochraceous-yellowish. Gills rather distant, adnate, pallid with a tinge of yellow (edge pale), when ripe yellowish-cinnamon. It has a very faint smell (of peach-leaves or bitter almonds).

19. **I. posterula** Britz. ex Sacc. Plate III, fig. 6.

Spores broadly ovate, $7^1/_2$—8 × $4^3/_4$—5 μ Cystidia fusoid, muriculate, about 10—12 μ broad.

Fig. specim.: Aarup, in wood of Pinus and Picea, Sept. 1916.

Cap 3—5 cm, at first somewhat campanulate, then expanded,

with small umbo, at first almost smooth, later somewhat fibrillose and slightly rimose, pale ochraceous, umbo subfulvous. Veil evident, fibrillose. Stem without bulb, somewhat clubshaped (base 7—11 mm, apex 5—7 mm), white, apex at last slightly brownish, not pruinose but with white silky fibrils and slightly flocculose above. Gills rather crowded, adfixed, at first whitish then pallid cinnamon with a flush of yellowish.

This species differs from *I. fastigiata* by the fusoid cystidia, from *I. Cookei* by want of bulb and by the muriculate cystidia. — The *I. descissa* of Ricken (l. cit., p. 104) appears to be identic.

20. **I. auricoma** (Batsch).

Spores $9-9^1/_2 \times 5\ \mu$, obliquely ovate, pale brownish-yellow. Cystidia on edge: a) ovate-clubshaped, b) obtusely bottleshaped, about $12\ \mu$ broad, slightly muriculate.

Fig specim.: Hjallese, copsewood (Corylus, Quercus etc.), Aug. 1915 (and in other similar localities).

Cap $1^1/_2$ cm, conic, then expanded and umbonate, at first smooth, then rimoso-fibrillose. The young cap is pallid ochraceous, but soon the fibrils become deeper yellowish-ochraceous. Stem subflocculose and somewhat fibrillose (apex slightly pruinose) not distinctly hollow. — The figure in Batsch: Elenchus Fungorum (V 21) does not show the fibrillose-rimose nature of the cuticle.

21. **I. pallidipes** Ellis et Everh. Plate III, fig. 7.

Spores somewhat obliquely ellipsoid, $10-11 \times 5-5^1/_2\ \mu$. Cystidia on edge: a) awlshaped-fusoid (free portion about $50\ \mu$ long), muriculate, b) short, cylindric-obovate.

Fig. specim.: Aarup, on naked ground (roadside) in wood, Sept. 1901. — Also found in some other similar localities.

Cap 2—3 cm, grayish-brown, at first minutely fibrillose-subflocculose (fibrils somewhat interwoven, whitish, silky), then somewhat rimose Veil well developed Stem cylindric, white, $3^1/_2$—4 cm. Gills narrowed behind, slightly adnate. Smell faint, spermatic.

This species is very intimately related to no. 10 and 11, and possibly not specifically distinct. — I formerly referred it to *I. perbrevis* (Weinm.); but as most modern authors use this name for a fulvous or rufous little mushroom without muriculate cystidia (vide Cooke loc cit. tab. 519, Massee, Monograph p. 490 etc.) I have dropped this name. The description of *I. pallidipes* in Massee's monograph (p 476) fits my plant very well. To judge from the description *I. entheloides* Peck (another American species) can hardly be specifically distinct

22. **I. descissa** Fr. *var.*

Spores obliquely ovate, $8^1/_2-10 \times 5\ \mu$. Cystidia fusoid-bottleshaped, about $15\ \mu$ broad, muriculate.

Fig. specim.: Hjallese, copsewood (Corylus etc.) Oct. 1898.

This little species, which is rather common in similar localites, differs somewhat from the current description of I. descissa. In my plant the stem is not hollow, the gills are adfixed and the fibrils of the distinctly rimose cuticle are rather dark brown.

23. **I. microspora** n. sp. Plate III fig. 8.

Spores $6^{1}/_{2}$—$7 \times 4$—$4^{1}/_{4}$ μ, obliquely ovate. Cystidia: a) obtusely fusoid-bottleshaped, about 14 μ broad, muriculate; b) small, obtuse.

Fig specim.: »Bleget« and »Frueskov« near Egeskov, gregarious in foliaceous wood, Sept. 1916. Also met with in other similar localities.

*Pileo 1,2—1,8 cm, primitus subconico, dein explanato et minute umbonato, pallide fusco-brunneo (centro obscuriore), primitus lævigato dein margine fibrilloso-subrimoso; stipite æquali, glabro nec pruinato sed apice leviter flocculoso, 3—4 cm × $1^{1}/_{2}$—3 mm, primitus pallido dein brunneo-pallido, subfistuloso; lamellis pallide fusco-cinnamomeis adnexis; odore nullo.*

Smaller and paler than no. 22. and not distinctly rimose.

## A. DEPAUPERATÆ.

### α. PYRIODORÆ.

24. **I. Bongardii** (Weinm.) Fr.

Spores ovato-ellipsoid, $13 \times 6^{1}/_{2}$ μ. Cystidia (on edge) crowded, obtusely cylindric-clubshaped, about 10 μ broad.

Cap 3—5 cm, obtusely umbonate, fibrillose-squamose, scales ochraceous-brown, towards the edge entirely split up into fibrils. Stem rather long, somewhat wavy, fibrillose, apex slightly mealy. Edge of gills white. All parts of the mushroom become flushed with incarnate when bruised or cut.

The large spores and clubshaped cystidia distinguish this species from all other pyriodorous species. The figure of FRIES (Icon. sel. II $107^{1-2}$) gives a very good idea of the habit of this species. As to the *I. Bongardii* of COOKE and MASSEE vide no. 4.

### β. INGRATÆ.

25. **I. calamistrata** Fr.

Spores oblong-oval, $10^{1}/_{2}$—$12 \times 5^{1}/_{2}$ μ. Cystidia inflated clubshaped, 12—18 μ broad. Fig. specim.: Hjallese, on naked, clayey ground under Alnus and Fagus, Sept. 1912.

This is the slender form figured by FRIES (Icones sel. $106^{2}$). The cap is only about 2 cm, the stem 5 cm × 3 mm. The base of the stem is clad with a whitish, often somewhat bluish-green tomentum (not so dark as figured by Fries).

26. **I. delecta** Karst. Plate III fig. 9.

Spores oval-phaseoliform, $7—9^1/_2 \times 5\ \mu$. light brownish yellow. Cystidia cylindric-clubshaped, 7—11 μ broad. Sporepowder ochraceous-cinnamon.

Fig. specim.: Aarup, grassy border of drive in plantation of Picea, (sandy soil) gregarious, Sept. 1916.

Cap $2^1/_2$—4 cm convex-plane, at first velvety-tomentose, then velvety squamulose, at first pallid ochraceous-brown, later on becoming vividly ochraceous-fulvous in the middle and honey-coloured-ochraceous towards the edge. Veil evident, arachnoid. Stem somewhat hollow, at first pale then sordidly yellow-brown floccose-fibrillose, rather short, 3–6 mm broad. Gills rather crowded, slightly emarginate with a small decurrent tooth, at first yellowish-white (edge white) then yellowish-brown or cinnamon. Flesh of cap slightly ochraceous, of stem pale dirt-yellow.

Karsten cites *I. cæsariata* v. *fibrillosa* as a synonym, what the rude figure of Fries (Icon. sel. tab. 109[3]) makes not unlikely. The plant described by Sev. Petersen (loc. cit.) sub nom. *I. flocculosa* Berk. is undoubtedly identical, to judge from the careful description given. — It forms a transition to the *Flammula*-type (of the *velutini*-group) especially *Fl. Agardhii.*

I. **Cookei** Bres.

Spores oval, subphaseoliform, $7—8 \times 4^1/_4\ \mu$. Cystidia crowded, inflated clubshaped or subglobular, 16—22 μ broad.

Fig. specim.: Hjallese, copsewood, Sept. 1898. Not uncommon.

The stem is faintly striate, not powdery-pruinose, apex slightly flocculose-fibrillose. — The bulbous stem (and different cystidia) distinguishes it from *I. posterula*; the smooth spores and not pruinose stem from *I. prætervisa.* — *I. rimosa* (Ricken, nec. al.) seems to me almost identical; and so is *I. confusa* Karst (Kritisk öfversigt of Finlands basidsvampar. Tillägg I. p. 35), only larger and with larger spores. It is very well figured by Bresadola (Fungi Trid. tab. 121).

28. **I. squamata** n. sp. Plate III fig. 10.

Spores broadly ovate-ellipsoid, $9^1/_2—10 \times 5^1/_2—6^1/_4\ \mu$. Cystidia crowded, clubshaped, 11—15 μ broad.

Fig. specim.: Vormark, in grass behind a hedge (planted with Populus) on clayey ground, Oct. 1901. — Also, in similar locality, Vaasemose 1904.

*Pileo carnoso, conico-expanso, 3—7 cm lato, subumbonato, fibrilloso et subrimoso, parte centrali in squamis adpressis disrupto, fulvo-lutescente, squamis obscurioribus; Stipite 3—7 cm × 5—10 mm, æquali solido, primitus pallide brunneo, dein saturatiore, fibrilloso-striato, intus leviter colorato; lamellis subliberis, primitus sordide flavo-albidis, dein brunneis cum tinctura fusco-flavis, margine albo. Sporæ et cyst. ut supr.*

This species is very closely related to *I. fastigiata*, forming a transition from I. fastigiata to *I. mimica* Massee (which has larger spores). — *Ag. Curreyi* Berk., which Massee refers to I. fastigiata, seems to be intermediate between the typical I. fastigiata and I. squamata (to judge from Cooke's figure (l. c. tab. 398).

29. **I. fastigiata** (Schæff.)

Spores oval-subphaseoliform, 10—11 × $5^1/_2$ μ. Cystidia cylindric, obtuse, about 12 μ broad.

Fig. specim.: Hjallese, in wood of Fagus and Corylus, July 1905. Not uncommon.

The cap in this species varies more or less acute, the stem is fibrillose-subfloccose, (not pruinose). Like most modern authors I use the name I. fastigiata for this smooth-spored species, excluding diverse rough-spored ones. — *I. flavella* Karst. as far as I can see only differs in larger spores. Bresadola's figure is somewhat exaggerated, very acute with almost green gills. — *I. fastigiata* var *superba* Fries (Icon. sel. tab. 108) hardly belongs here.

30. **I. perlata** Cooke.

Spores ovate, somewhat oblique, $9^1/_2$—$10^1/_2$ × $6^1/_2$ μ. Cystidia cylindric-clubshaped, 11 μ broad.

Fig. specim.: Tommerup, old grassfield behind copsewood, gregarious, July 1914.

Cap 5—$6^1/_2$ cm, somewhat conical, at last expanded and subumbonate (when moist subviscid), even, very minutely fibrillose, umbo fuscous-brownish, whitish towards the edge, later on becoming fibrillose-subrimose, the fibrils darker. Stem about 8 cm × 10—12 mm, at first white, somewhat fibrillose (not mealy), then turning brownish inside and outside (from base upward). — My plant is not quite so large as Cooke's figure.

31. **I. brunnea** Quél.

Spores 9—11 × 5—$5^1/_2$ μ. Cystidia on edge of gills inflated club-shaped, 12—15 μ broad.

Fig. specim.: Hjallese, behind a hedge, Sept. 1902. — Rather common in light foliaceous woods, often gregarious.

The more or less bright chestnut-brown colour of the cap distinguishes this species from its allies. The bulbless stem is originally almost white but soon becomes partly flushed with brown.

When in bud the central part of the cap is often partly covered by whitish adpressed scales and fibrils which soon disappear. When this rudimentary universal veil is very apparent we have, I believe, *I. maculata* Boud.

32. **I. jurana** Pat.

Spores broadly obliquely ovate, $9\frac{1}{2}$—$10\frac{1}{2} \times 6$—$6\frac{1}{2}$. Cystidia clubshaped. Basidia 4-spored.

Fig. specim.: A. Hjallese, walk in copsewood, Aug. 1915. B. simlar locality, Aug. 1909. — Also collected in a wood of Fagus, near Høbbet, Oct. 1916.

Cap at first conical, then expanded, umbonate, everywhere covered by dark violet-fuscous (at last very dark fuscous) fibrils, which in the middle form adpressed scales, while towards the edge the pale bottom-colour is seen between the fibrils. Stem slightly bulbous, apex indistinctly flocculose, fibrillose below, of a dingy violet-incarnate colour. Gills at first whitish-gray, then grayish-brown (edge whitish) slightly adfixed. Flesh (especially about the umbo and the lower part of the stem) vinous lilac-incarnate. Smell faint.

Bresadola refers I. jurana to what he calls *I. frumentacea* (Bull.), from a figure in Bulliard's work (Champ. de France 571[1]) which other authors think represents a *Hygrophorus* (or something else). To judge form his own description and figure (loc. cit. tab. 200) his plant is not unlike mine, except for the »frumentaceous« smell which is lacking in my plant.

33. **I. rhodiola** Bres.

Spores obliquely ovate, 9—10 × 6 μ. Cystidia clubshaped, 11—13 μ broad.

Fig. specim.: Egeskov, grassy drive in foliaceous wood, Aug. 1914.

Cap expanded-conical, about 5 cm broad, rather acutely umbonate, bottom-colour pale brownish-ochraceous (umbo subincarnate), everywhere with darker (brownish) very subtile fibrils, at last slightly rimose. Stem 7 cm × 6 mm, fibrillose-striate, not bulbous, from base upward turning pallid-rosy (inside and outside), as does also the flesh about the umbo. Gills at first grayish, then dull cinnamon, with whitish edge, almost free.

It is perhaps no more than a pale and slender form of the preceding species (and Bresadola himself unites them in vol. II of Fungi Tridentini) but their habit is very different.

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## II. CLYPEUS.

### A. CALOSPORÆ.

34. **I. calospora** Quél. (= *I. echinospora* Egeland).

Spores broadly oval or subglobular ($8\frac{1}{2}$—10 × 7—8 μ), set whit $1\frac{1}{2}$—3 μ long, hardly 1 μ broad cylindric aculei, sub micr. brown.

Cystidia on edge of gills numerous, about 10—11 μ broad, often somewhat muriculate.

Fig. specim.: A: Killerup, gregarious in moist wood of Fagus, amongst Juncus bufonius etc., July 1905. B: Fruens Bøge, drive in foliaceous wood, Aug. 1907.

Cap 1—$1^1/_2$ cm, at first conic-convex, then expanded with minute umbo, brown, central part set with minute recurved squamules. Stem even, slender (2—3 cm × $1^1/_4$ mm), *Naucoria*-like, slightly hollow, especially above with minute white squamules, brown. Gills free, broad (2—3 mm), rather distant and at last rather thick. Flesh of stem brown. — B is a little larger, darker and more densely white-flocculose.

In the diagnosis of *I. calospora* (Fungi Tridentini I) the spores are said to be globose, and for this reason I formerly dared not refer my plant to this species. But authentic specimens from Bresadola, which I have had the opportunity to examine, have spores exactly like mine. Massee's figure of the spore of *I. calospora* (Monograph, tab. 32 fig. 12) is exaggerated and misleading, showing an enormous globose spore, about 20 μ diameter, with coarse, about 3 μ broad papillæ. The spores are really more like his figure of *I. Gaillardii*, only the aculei are shorter and blunter. — These two species appear to be very closely allied. My first find (A) is more like I. Gaillardii in size etc.

*I. echinospora* Egeland (Nyt Magazin f. Naturvidenskaberne, Vol. 51 [1] 1912) is identical. Also *I. lanuginosa* (sensu Schroet.) seems to belong here.

## B. ASTROSPORINÆ.

### α. MURICULATÆ.

### 35. I. asterospora Quél.

Spores 9—12 × $7^1/_2$—9 μ, stellate (with 5—8 strongly prominent obtusely conical projections). Cystidia ventricose-bottleshaped, muriculate. — The velvet pruina on the stem consists of similar cystidia (1916).

Fig. specim.: Hjallese, mixed foliaceous wood, Sept. 1896. — Rather common.

This characteristic species is well distinguished by the strongly rimose, dark brown cap, and the velvety-pruinate, marginately bulbous stem, which soon turns brown all over (except the bulb).

### 36 a. I. prætervisa Quél.

Spores 10—12 × 7—9 μ, somewhat irregularly substellate (with 5—8 coarse, obtuse warts). Cystidia 12—14 μ broad, fusoid-cylindric, apex muriculate.

Fig. specim.: Hjallese, copsewood, Sept. 1890. — Not uncommon, in foliaceous woods; also met with in wood of Pinus (Aarup 1916).

Like *I. asterospora* it has a minutely pruinose, marginately bulbous stem; but the cap is ochraceous, less strongly rimose. Probably *I. subrimosa* Karst. is not specifically distinct: the only notable difference is in the spores, which KARSTEN says are 13—14 × 10—11 μ. (Kritisk Öfversigt, Tillägg I p. 36). MASSEE — chiefly on account of the large spores — includes it in *I. asterospora*.

36. **I. p.** var. **pusilla** J. E. Lange. Plate III fig. 11.

Spores $10^1/_2 \times 7^1/_4$ μ, somewhat irregular, with 7—8 prominent but rather blunt, coarse warts. Cystidia fusoid-bottleshaped, 60 × 15 μ (the neck about 9 μ), muriculate.

Fig. specim.: Odense Hed, on boggy ground under Salix cinerea, Aug. 1916, gregarious. – Also found in other similar localities in Fyn (and in Jylland by Poul Larsen).

Cap 1.2—1.8 cm, at first conic-campanulate, then expanded with a small rather acute umbo, yellowish-brown, minutely fibrillose, then subrimose and slightly darker brownish. Stem 4 cm × $1^1/_2$—2 mm, pale above, rest yellowish-brownish, minutely striate and everywhere velutino-pruinose. Bulb small, marginate. Gills at first pale, then date-brownish, rather distant, free.

Although this little tiny plant is not half the size of the ordinary I. prætervisa (and more like a *Naucoria* than an *Inocybe*) I do not think it deserves to be put up as a distinct species, as all its microscopic and macroscopic characters are almost identic.

37. **I. fibrosa** (Sow.) var. **trivialis.**

Spores very irregular with prominent and pointed base, 9—13 μ long, with subglobular warts. Cystidia inflated, about 18 μ broad, apex somewhat muriculate. Basidia occasionally with only 2 or 3 sterigms.

Fig. specim.: Hjallese, clayey ground in garden under Populus, Sept. 1902 (and July 1903). — Found in several places in light foliaceous woods, especially under poplars.

Cap fleshy, obtusely conical (3—4 cm broad, 2—3 cm high), central part pallid argillaceous, rest pale dingy brownish. Surface slightly viscid, minutely fibrillose (but not truly rimose), edge often irregular. Stem white, firm (6—10 mm) almost equal (below ground with a slight bulbous swelling), even and almost glabrous. Gills rather crowded, almost free, white then pallid brownish-gray.

An uncommonly large and pale, almost white form of this species I have met with in Jylland (near Langaa 1914); this constitutes the *I. fibrosa* proper (as figured by BRESADOLA l. c. tab. 56). The more trivial form here figured approaches *I. prætervisa*, but differs by the white, almost glabrous stem and want of distinct bulb etc. *I. fastigiata* var. *superba* (Fries: Icon. sel. tab. 108) might be a rather dark, large form of this species.

38. **grammata** Quél. (= *I. hiulca* Bres. nec al.).

Spores $7^1/_2$—9 × 5—6 μ, nodulose. Cystidia bottleshaped, 15—18 μ broad.

Fig. specim.: Stenløse, in wood of Fagus and Corylus, gregarious, Oct. 1916.

Cap $2^1/_2$—4 cm, convex, with small, rather acute umbo. The umbo is whitish, glabrous. The cuticle of the cap is made up of delicate, silky whitish fibrils (which are densest towards the edge), through which the pale, dingy-incarnate-brownish flesh is seen. Stem tall (4—$7^1/_2$ cm), even, everywhere minutely pruinose, inside and outside pallid brownish-incarnate, base whitish and terminating in a subterraneous, white, somewhat marginate bulb. Gills dirt-grayish, narrowed behind, adnate.

*I. hiulca* (Kalkbr.) sensu Bresad. (very well figured in Fungi Tridentini tab. 122[2]) is evidently identic; but as I. hiulca is a very disputed species, which has been construed to mean almost everything, I think it better to use Quélet's name.

39. **I. napipes** n. sp. Plate III, fig. 12.

Spores 9—10 × 6 μ, with 5—6 rather prominent nodules or warts. Cystidia generally muriculate, about 50—60 × 12—18 μ.

Fig. specim.: Knagelbjerg Skov near Faaborg, on boggy ground under Betula and Pinus, Nov. 1907. (Also found at Ryslinge in moist foliaceous wood, Aug. 1908, and near Hobro, in boggy wood.

*Pileo 3—5 cm, ex conico-campanulato expanso et acute umbonato, obscure brunneo vel umbrino, primitus sublævi, minute fibrilloso, dein fibroso-rimoso; Stipite elato, bulbosus (bulbus subdepressus nec marginatus) brunneo, sursum pallescens, leviter striato, minute fibrilloso (nec pruinato); lamellis subconfertis, angustis, subliberis, ex albido-griseis brunneis. Sporæ et cyst. ut supr.*

*I. carpta* Bres. (nec al.) differs in bulbless stem etc.

40. **I. umboninota** Peck *var.* Plate III, fig. 13.

Spores $9^1/_2$—11 × 6 μ, conic-ellipsoid, with 5—7 obtuse warts. Cystidia about 15 μ broad, prominent portion obtusely conic-cylindric, apex slightly muriculate or smooth.

Fig. specim.: Roldskovene (near Skørping), roadside in mixed wood, on mossy ground, Sept. 1900.

Cap $1^1/_2$—$2^1/_2$ cm, convex, with a very prominent, rather acute, conical umbo, chestnut-brown, fibroso-rimose. Stem short, base slightly swelled, glabrous, glossy, slightly striate, chestnut-brown. Gills ventricose, broad, adfixed, becoming cinnamon-chestnut. Flesh of cap white, of stem chestnut-brownish.

My plant is smaller than Peck's and has somewhat larger spores.

41. **I. umbrina** Bres.

Spores 8—9 × 5—6 μ, nodulose-angulate, with more or less prominent obtuse nodules. Cystidia fusiform-bottleshaped, about 14 μ broad, apex somewhat muriculate.

Fig. specim.: Vaasemose, wood of Fagus, Oct. 1915. – Also found in wood of Picea (very numerous), Gerup, Oct. 1916 and in Jylland (P. Larsen), and Sjælland (Sev. Petersen).

Cap 1,8—2,5 cm, convex, slightly umbonate, innately fibrillose, subviscid. Stem not hollow, minutely fibrillose-striate, apex slightly powdered, bulbous (bulb occasionally marginate, subterraneous). Gills at first claycoloured-brownish, narrowed behind and somewhat adnate. Veil evident but fugacious. The whole plant is at first pale brownish but soon turns darker brown (except the white bulb).

Differs from Bresadola's description and figure (Fungi Trid. tab. 55) by being somewhat smaller, the gills not yellowish at first. — *I. Rennyi* Berk. et Br. (Cooke's illustr. tab. 520 A) looks very much like my plant, but has no bulb.

42. **I. plumosa** Quél. (nec Bolt.) (?).

Spores $9^1/_2$—12 μ long, oblong, nodulose-warty, somewhat oblique. Cystidia dispersed, variable, ventricose, muriculate, 15—20 μ broad.

Fig. specim.: Vormark, sandy and stony common on the coast of Store Belt, under poplars, Oct. 1901.

Cap rather fleshy, $6^1/_2$ cm, gibbous, edge at last turned upwards: central part almost even, but for the rest fibrillose-subsquamulose (not rimose), brown (colour of *Tricholoma imbricatum*). Stem equal, rather short, 1 cm broad, slightly fibrillose, paler than cap. Gills crowded, at first dingy white, then pallid grayish-brown, adnate. Flesh white. Not hygrophanous but somewhat paler when dry.

As I have only found this species once (some few, rather overgrown specimens) I cannot decide whether it is the true *I. plumosa* of Quélet. It has much in common with *I. carpta* Bres. (nec al.) (Fungi Trid. tab. 54), (which Quélet cites as a synonym to his I. plumosa), but is not so dark and without the acute umbo.

43. **I. lanuginella** Schroet.

Spores 8—$9^1/_2$ μ, oblong, outline with about 5 obtuse nodules. Cystidia inflated fusoid, 15—16 μ broad, smooth or somewhat muriculate. Fibrils on cap septate, about 7 μ broad.

(Spores oblong, irregularly nodulose (with 7—8 obtuse nodules) (1900).

Fig. specim.: Killerup, on moist ground (Juncus bufonius etc.) in foliaceous wood, July 1905. — Also found at Arden, under Salices in garden (1900), and at Lammehave 1905.

Cap $1^1/_2$—3 cm, at first conic-convex, then plane-convex with small umbo, grayish-brown, at last dingy ochraceous brown, tomentose-fibrillose-subsquamulose. Veil evident, arachnoid. Stem pallid, base dingy brownish, minutely silky-fibrillose, rather short. Gills rather crowded, at first pallid then grayish-brown.

My plant is somewhat larger than described by SCHROETER (Die Pilze Schlesiens I, p. 577) Possibly it is not specifically distinct from *I. curvipes* Karst. Also *I. cicatricata* Ellis et Everh. appears to be almost identic. Habitually it has much in common with the smoothspored *I. pallidipes* (no. 21).

### 44. **I. putilla** Bres.

Spores $8^1/_2$—$9^1/_2$ × 6—$6^1/_2$ μ, obtusely nodulose (outline with 5—6 nodules). Cystidia fusoid-bottleshaped, about 15 μ broad, muriculate

Fig. specim.: Hjallese, on the ground in copsewood (Corylus), solitary, Aug. 1915.

Cap 1,2 cm, acutely conic, minutely fibrillose, at last slightly rimose. Stem whitish, flushed with dingy incarnate (especially downward), bulbless. Edge of gills minutely crenulate. — Smaller than desribed by Bresadola. It has much in common with no. 43.

### 45. **I. rufoalba** Pat. et Doass. Plate III, fig 14.

Spores irregularly ovate, outline with about 6 obtuse nodules, 7—8 μ long. Cystidia: a) bottleshaped, muriculate, b) obovate.

Fig. specim.: Aarup, sandy road in plantation of Picea, gregarious, Sept. 1910.

Cap 1—2 cm, at first conic convex, then expanded, more or less gibbous, when young brownish, everywhere whitish-tomentoso-pilose, later on darker (subferruginous, umbo darker brown), tomentoso-squamulose Margin without veil. Stem outside and inside somewhat ferruginous, short ($2^1/_2$—3 cm × $1^1/_2$—3 mm), often wavy, not bulbous, at last slightly hollow, apex with white powder, rest slightly fibrillose-flocculose. Gills broad, rather distant, ventricose, narrowly adfixed or almost free, at first argillaceous-brownish, then ochraceous-rusty brown — Generally subfasciculate

A very distinct little species, well characterized by the white, pilose tomentum.

### 46. **I. petiginosa** Fr.

Spores $6^1/_2$—7 × $4^1/_2$ μ, outline broadly ellipsoid, irregularly wavy-nodulose Cystidia crowded, free portion elongated-conic, about 10 μ broad, muriculate. — The stem is densely set with similar cystidia (1910).

Fig. specim.: Hjallese in moist copsewood (Fagus etc.), Sept. 1898. — Common, especially on and around old rotten stumps of Fagus.

This elegant little species (easily recognized by the brownish, everywhere minutely pruinate stem, white agglutinate squamules and pale yellowish gills) was in later years transferred to *Hebeloma* by Fries — Schroeter (loc. cit.) describes it very well sub. nom. *Astr. scabella* (Fr.).

### β. DEPAUPERATÆ.

47. **I. lanuginosa** (Bull.).

Spores 10 × 7 μ, outline with about 7 obtuse, but prominent warts. Cystidia obtuse, 16—20 μ broad, inflated, generally broadest below middle.

Fig specim.: Ryslinge, on moist ground in wood of Fagus, amongst ferns, Oct. 1908. — Also found at Lykkesholm (1909), on old stump of Fagus, and in a bog under Salices and Picea, Langesø, Oct. 1909. a. o. localities.

Some authors distinguish between two species: a xylophilous one: *I lanuginosa* Bres. and a terrestrial one: *I. sabuletorum* (B. et Curt.). Like Massee (l. cit., pag 468) I see no real difference between the two. — *I. lanuginosa* sensu Schroet. vide no. 34. — Possibly some of the forms described by Sev. Petersen under *I. relicina* belong here. — The plant is well characterized by the umber-brown, velutino-squamulose cap, the central part of which has minute, erect squamules, while the stem has brown, floccose squamules. — (What *I. relicina* really is, I do not know. Quélet, Massee and others describe it as a small, smoothspored fungus, while Schroeter's description depicts a gigantic I. lanuginosa). — *Clypeus squarrosulus* Karst (Symbol ad Myc. Fennic. XXXII) seems to me exactly like I. lanuginosa.

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STURM: Deutschlands Flora: Pilze, bearb. von Dittmann u. a. Nürnberg 1817.

# SPECIFIC INDEX.

# PLATE I.

All spores shown magnified 800 times, cystidia and surface-cells 300 t. The numbers correspond to the current no. of each species in the text.

(All figures are from fresh material: no dried or preserved specimens used.)

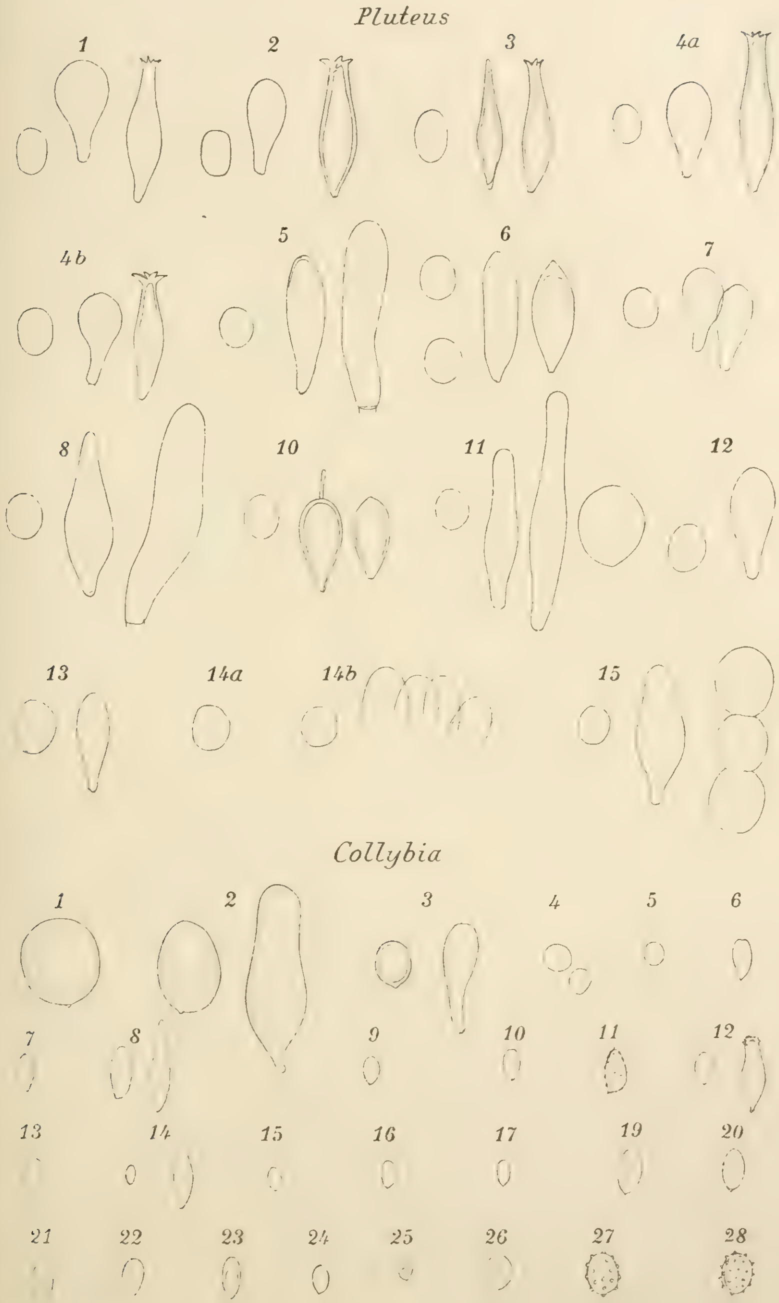
## Pluteus.

| | | | | | |
|---|---|---|---|---|---|
| 1. | P. cervinus | spore | cystidium | from edge | and face |
| 2. | - salicinus | — | — | — | — |
| 3. | - petasatus | — | | — | — |
| 4a. | - pellitus | — | — | — | — |
| 4b. | - — var | — | — | — | — |
| 5. | - gracilis | — | — | — | surface-cell |
| 6. | - Roberti | — (of a and b | | — | |
| 7. | - hispidulus | — | — | — | |
| 8. | - plautus | | — | | — |
| 10. | - cinereus | — | — | | |
| 11. | - semibulbosus | — | — | | — |
| 12. | - Godeyi var | — | -- | | |
| 13. | - cinereo-fuscus | — | | | |
| 14a. | - nanus | — | — | | |
| 14b. | - — lutescens | — | — | | |
| 15. | - chrysophæus | — | — | | surface-cells. |

## Collybia.

| | | | |
|---|---|---|---|
| 1. | C. (Arm.) mucida, | spore | |
| 2. | - radicata (arrhiza) | — | cystidium |
| 3. | - platyphylla | — | — |
| 4. | - maculata | — | |
| 5. | - distorta | — | |
| 6. | - butyracea | — | |
| 7. | - fusipes | — | |
| 8. | - velutipes | — | — |
| 9. | - dryophila | — | |
| 10. | - macilenta | — | |
| 11. | - nitellina | — | |
| 12. | - tenacella | — | — |
| 13. | - confluens | — | |
| 14. | - conigena | — | — |

| | | |
|---|---|---|
| 15. | C. tuberosa | spore |
| 16. | - cirrhata | — |
| 17. | - racemosa | — |
| 19. | - rancida | — |
| 20. | - inolens | — |
| 21. | - murina | — |
| 22. | - clusilis | — |
| 23. | - miser | — |
| 24. | - ozes | — |
| 25. | - mephitica | — |
| 26. | - cessans | — |
| 27a. | - erosa | — |
| 28. | - tesquorum | — |

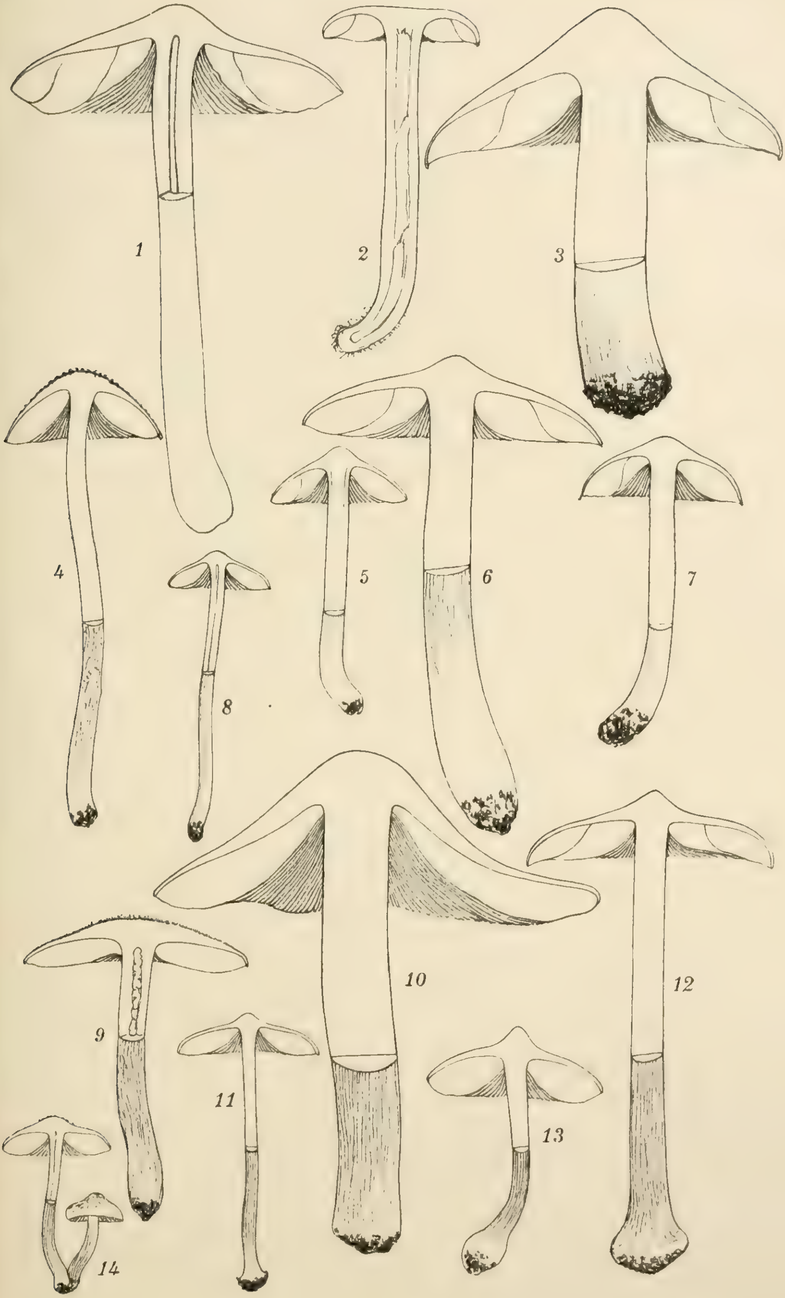



Jakob E. Lange del.

# PLATE III.

All figures natural size.

| | | | |
|---|---|---|---|
| 1. | Pluteus cinereo-fuscus | 8. | Inocybe microspora |
| 2. | Collybia ozes var. | 9. | — delecta |
| 3. | Inocybe albidula | 10. | — squamata |
| 4. | — griseo-lilacina | 11. | — prætervisa v. pusilla |
| 5. | — pusio | 12. | — napipes |
| 6. | — posterula | 13. | — umboninota |
| 7. | — pallidipes | 14. | — rufo-alba. |




*Jakob E. Lange del.*

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1918

# Contributions to West Australian Botany.

By

**C. H. Ostenfeld.**

## Part II.

**C. H. Ostenfeld:** Stray Notes from the Tropical West Australia. (Pl. I III).
**C. H. Ostenfeld:** A Revision of the West Australian Species of Triglochin, Crassula (Tillæa) and Frankenia. (Pl. IV).
**Ove Paulsen:** Chenopodiaceæ from West Australia. (Pl. V—VI).

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## Stray Notes from the Tropical West Australia.

By

**C. H. Ostenfeld.**

The flora of the tropical part of West Australia is — as mentioned in the Introduction (p. 3)[1] — not well known. While the flora and vegetation of the extra-tropical, south-western part have been investigated by many botanists, no professional botanist has explored that part of W. A. which lies north of the tropic of Capricorn.

Our main special sources for the knowledge of this flora are some plant lists published by the late F. v. Müller[2] on the material brought home by the late Sir John Forrest from his audacious exploration journeys. Of course, during such expeditions not much attention can be paid to botanical collecting, and it is really admirable how much Sir John Forrest did do in the way of securing herbarium specimens.

[1] Ostenfeld, C. H.: Contributions to West Australian Botany. Part I. Dansk Botan. Arkiv, Bd. 2. No. 6. 1916.

[2] Müller, F. v.: Plants of North-Western Australia. Presented to the Legislative Council by His Excellency's Command. Perth 1881.
— The Plants indigenous around Sharks Bay and its vicinity. Ibid., 1883.

Besides these lists, many contributions to the flora are to be found scattered in BENTHAM's Flora Australiensis (1863—1878),[1] in F. v. MÜLLER's Fragmenta Phytographiae Australiae I—XII (1858—1882), and in his monographs. The "List of Extra-tropic West Australian Plants" published in the Western Australian Yearbook for 1900—01 (vol. I, Perth, 1902) is a revised and augmented edition by A. MORRISON of an earlier list compiled by F. v. MÜLLER. In spite of its title it contains — according to information in a footnote — also the names of plants "recently recorded from within the tropical line"; but being a mere enumeration of plant-names it does not contain any indication as to which part of W. A. a species has been found in, and it is therefore impossible to decide if it came from the tropical or the extra-tropical W. A. The list states only that it has been taken within the borders of the State of W. A.

In some recent contributions to the flora of Australia we find several records for the tropical W. A.: viz. in K. DOMIN's papers,[2] and in E. CHEEL's list of plants collected by the Swedish Zoologist Dr. E. MJÖBERG in W. A. and Queensland.[3] A paper by B. P. G. HOCHREUTINER[4] on his collections of plants from different parts of the world contains a few records from W. A. where he went on a flying visit in 1905.

Valuable contributions to our knowledge of the flora of the farthest north and north-east of W. A. are afforded by the different papers on the flora of the Northern Territory published recently from S. Australia by A. J. EWART and others.

Most of the records in the papers here given are the results of short and chance visits to the country; Dr. Mjöberg's collection, however, was made during a longer stay in the Kimberley district. It must be admitted that the collection is not large, and it is really a pity that this excellent explorer, who spent

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[1] In BENTHAM's Flora all the earlier records have been incorporated.

[2] DOMIN, K: Additions to the Flora of Western and North-Western Australia. — Journ. Linn. Soc. Botany, XLI, Dec. 1912.
— Beiträge zur Flora und Pflanzengeographie Australiens. I Teil. Bibliotheca Botanica, Heft 85, 1915.

[3] CHEEL, E.: Plants, in Results of Dr. E. Mjöberg, Swedish Scientific Expeditions to Australia 1910—13. Kgl. Svenska Vetensk. Akad. Handl. Bd. 52, No. 10. 1916.

[4] HOCHREUTINER, B. P. G.: Plantæ Hochreutineranæ, fasc. I. — Ann. du Conservatoire et du Jardin botan. de Genève, 15—16. Ann. 1911—1913. See also his paper: Un nouveau Baobab et revision du genre Adansonia. Ibid. 11—12. Ann., 1908.

nearly a year in the most interesting part of the tropical W. A. for zoological and ethnographical studies and travelled far into the interior, did not have a professional botanist with him. —

No doubt the botanical exploring of the tropical part of W. A. — often called "The Nor'west" — would be an interesting and paying object for a scientist who could afford to devote some time (perhaps a year) to it, and could stand the climate. My own flying visits at different places along the coast, made when the steamer stopped for taking in cargo, gave me the impression that a study of the vegetation would raise many interesting problems both with regard to flora, plant-geography and ecology.

It goes without saying that what I could do during such short time and only in the immediate surroundings of the regular stopping places for the steamer, was not much. Still I find it worth publishing, as we know so very little from this part of West Australia, and in the following I shall give some descriptions — I admit only very incomplete — of the vegetation of the coast region, and further enumerate the species collected.[1]

I visited this part of W. A. in the first days of November 1914 and called at the following places (north of the Capricorn): off Onslow (Nov. 1st), Point Samson, near Cossack (Nov. 2nd), Port Hedland (Nov. 3rd-4th), Broome (Nov. 5th) and Derby, King Sound (Nov. 6th-7th).

## I. Some general Remarks on the Vegetation.

The tropical part of W. A. is a part of the immense plateau, of which nearly the whole western half of Australia consists.[2] But the surface is not as even or undulating as farther south. We find real mountain landscapes both towards North-west, where Mount Bruce, the highest point of W. A., rises to a height of 1226 m, and towards North (the Kimberley division), the highest point of which is Mount Hann (850 m). In both these regions the coast is more or less indented and provided with islands, and

[1] It would have been interesting to compile a list of the flora of the tropical W. A., but from what is said above it seems evident that it is not possible to solve this matter, many of the records of the floras and lists being too indistinct as regards their geographical positions.

[2] Jutson, L. T.: An Outline of the Physiographical Geology (Physiography) of Western Australia. Geol. Surv. Bull. No. 61. Perth, 1914.

the mountains reach the coast in many places. In other places a low foreland is present, as is also the case in the intermediate district, especially "the Ninety Mile Beach" from Port Hedland to Broome. This foreland is sandy and covered by dunes; in bays and outlets of the rivers the mangrove sets in.

The climate[1] is tropical and dry. The average temperature for Broome (Lat. 18° S.) is 26° 6 C., the hottest months being December and January with an average of 29° 9 C., and the coldest June—July with 21° 7—21° 8 C. (see Fig. 2). But the maximum temperatures rise much higher, and their effects upon the vegetation must be very pronounced. We learn that a temperature of 49° C is not very rare in the interior, and 38° C not rare at the coast. Especially significant is the fact that periods of uninterrupted high temperature sometimes occur. E. g. the temperature did not sink under 37° 8 (100° F.) in 64 consecutive days in 1902 at Marble Bar, nor in 57 days in 1900 at Nullagine, two places in the interior of the north-western district. No doubt such prolonged heat spells must have a very disastrous result as regards the plant world, at least when not accompanied by rain.

And rain, the second important climatic factor, is scanty. The rainfall increases from the north-western corner towards north-east (see Fig. 1), but in no district does it reach such a degree that a rich tropical vegetation can thrive. The north-western district is in reality a desert, the average annual rainfall not reaching c. 500 mm (20 inches) in any place, while the best part, the northern Kimberley, has a rainfall between 750 and 1000 mm (30—40 inches); Broome, the best meteorological station, at the south western corner of Kimberley has 583 mm (22.96 inches). There is thus a considerable difference in this respect between the north-west and the Kimberley districts, and what makes this difference even more perceptible than the figures show, is the regularity of the rainfall in the Kimberley district and the irregularity in the north-western district. In the latter, the rainfall differs greatly from year to year. The rain here comes usually with the hurricanes, which sweep over the country during the summer, but are very capricious in their occurrence. During year-long periods hardly any rain falls, and then a hurricane brings

[1] See: Hunt, H. A.: Climate of Australia, in Federal Handbook of Australia, prepared in connection with the 84th meeting of the British Association for the Advancement of Science held in Australia August 1914. Melbourne 1914. See also: W. A. Year-Book for 1900—1901, vol. I, Perth 1902, pp. 135—157.

in the course of a few days a downpour which exceeds the yearly average. Thus I was told in 1914 that Onslow had had practic-


Fig. 1. Rainfall Map of Western Australia showing isohyets (in inches). (From Yearbook of the Commonwealth of Australia, 1913, after Jutson, Geol. Surv. Bull. 61, 1914).

ally no rain during the past 4 years. On the other hand, a rainfall of 928 mm (29.41 inches) in 3 days is recorded, in 1898, for

Whim Creek, not far from Onslow. It is evident that such an instability as regards the rainfall makes it impossible for most plants to exist, and the vegetation must be very poor, only consisting of expressed xerophytes which can endure both drought and high temperature. It is therefore no wonder that this country is a desert, the only green places being the mangroves along the coast.

Much better conditions rule in the Kimberley district, although the rainfall there is not nearly sufficient for a tropical country. The main rain period is in summer (December-March), and very little rain falls during the rest of the year. The diagram (Fig. 2) for Broome of rainfall and temperature shows that both curves follow each other in the main. The rain makes the existence of a richer vegetation possible, while on the other hand, the exceedingly dry winters, with their comparatively high temperature, restrict the luxuriance of the vegetation, the result being — in the best places — a savannah forest, in less favourable places a savannah or steppe or even a desert.

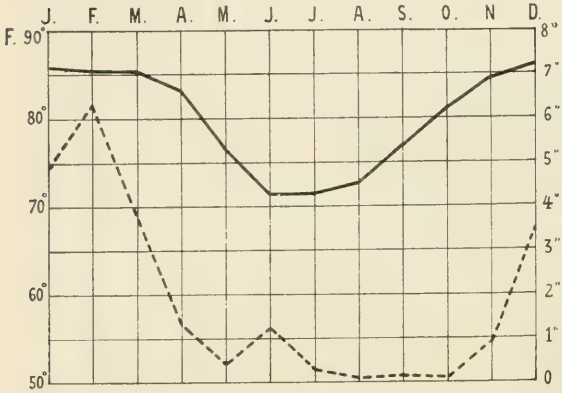


Fig. 2. Diagram, showing mean monthly temperature (the thick line) in degrees of Fahrenheit and mean monthly rainfall (the dotted line) in inches, at Broome.

I have premised these general remarks to make my few notes on the vegetation better understood. They concern only the vegetation of the coastal region, as my short visits at the different ports did not allow me time to travel farther in. The vegetation formations observed by me are the following:

1. The mangrove formation.
2. The sandy sea-shore formation.
3. The salt pan formation.
4. The sand dune formation.
5. The savannah forest.

## 1. The Mangrove Formation.

The West-Australian mangrove extends much farther south than the tropic of Capricorn. L. Diels[1] mentions it as far south as Bunbury (Lat. $33^1/_2$° S.), near the south western corner of the continent; but south of the tropic it is very monotonous, the Grey Mangrove (*Avicennia officinalis*) being its only wood-plant. This shrub, or small tree, is also the main component of the tropical mangrove of W. A., but it is not the only tree. At Point Samson (near Cossack) the low *Ceriops Candolleana* was common, and at Port Hedland the taller *Rhizophora mucronata* formed extensive growths along the inner part of the estuary, while *Avicennia* ruled at the outer part. At Derby, at the head of King Sound, where the large Fitzroy River has its outlet, the mangrove near the jetty had *Avicennia* as dominating species (Plate I, Fig. 1). But against its dull dark-green and grey foliage the bright and shining green of another low tree, which occurred only in scattered individuals, made a striking contrast. This was *Excoecaria agallocha* (var. *ovalis*), a plant widely distributed in the coast regions of the Old Worlds tropics.

In the higher lying parts of the mangrove at Derby a succulent undershrub formed a green cover under the shrubs; it was a form of *Suæda*. As it was without flowers and fruits, having shed the fertile branches, I could not refer it to its proper place, and am much indebted to Mr. J. H. Maiden for his help in this matter. He has named it *S. maritima*; but it differs greatly from the plant as I know it from the shores of Europe. Here, it is a perennial plant and its lower parts are woody. I think it ought to be taken as a species distinct from our European plant. This is also the opinion of dr. Ove Paulsen who has examined my *Chenopodiaceæ;* he names it *S. australis* (R. Br.) Moq.

The northern part of West Australia is known for its very pronounced tides. It is reported that the tide at Derby reaches to 10—15 meters and at Broome and Port Hedland not much less. The steamer arriving at high water off the head of a jetty, must remain there until next high water; and at low water time the water around it has quite disappeared, and it stands on the sea bottom supported by the logs of the jetty (see Fig 3). Such a marked difference between high and low water makes a strange impression on the visitor. He sees at high water the mangroves growing in water which reaches the green foliage of their crowns,

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[1] L. Diels: Die Pflanzenwelt von West-Australien südlich des Wendekreises. 1906, p. 207.

while at low water the trees stand with their trunks and bases exposed to the sun, and the sea bottom is laid bare for wide distances. In *Rhizophora* and *Ceriops* the arched aërial roots from the branches make, together with the stems, the whole scrub an inextricable confusion of grey stems, while as regards *Avicennia* the sea bottom is covered by its numerous small vertical asparagus-like aërial roots. The two photos (Plate I, Figs. 2—3) from Port Hedland were taken from just the same spot, with an interwal

Fig. 3. The steamer at low water leaning against the logs of the jetty at Derby. The sea has retired farther out than the steamer which stands on the naked sea-bottom (Nov. 7. 1914). Photo. by C. H. O.

of 6 hours, and show low *Avicennia* at high water standing in water until the crown, and at low water growing on the dry sea-bottom. (In some depressions water was left by the retiring tide and gives the impression that the bottom is not quite deprived of water).

The tides run with great force (10—12 knots at some places) and only such well fastened plants as the mangrove trees are able to stand it; therefore we do not find much vegetation between their roots. Usually the soil is quite bare, hardly any sea-weeds and no sea-grasses[1] being found. It was an exception to find the green carpet of the *Suæda* mentioned above, and this was only near the high water mark, where, probably, not every high water

[1] Compare: The Sea-Grasses of W. A., in Contr. to W. A. Botany I, p. 7.

reaches it. The mangrove formation of W. A. is consequently rather poor; it does not make such a luxuriant impression as do the Malayan and the West-Indian mangroves. Still, this evergreen fringe bordering the coast and estuaries refreshes the eye in these regions, where the other vegetation is far more reduced owing to the dry and hot climate.

When lying at anchor off Onslow, I saw a low mangrove at the outlet of Ashburton River, and at Broome I observed a large mangrove. They seemed to be of the same type as the mangroves described above, and I think the mangroves along the whole coast of the tropical W. A. are much like each other.

### 2. The Sandy Sea-shore Formation.

Where the coast is sandy — and this is the case over large distances — a scanty vegetation of halophilous annual herbs occurs. I had not much opportunity to observe this formation, which passes over into the dune-formation or in places into the salt-pan formation. At Port Hedland I saw it at the coast near the township, where it covered the ground just above high-water mark. It was dominated by large specimens of *Salsola kali*, and amongst them some plants of *Ptilotus villosiflorus* and *Trianthema crystallinum*[1].

The poor plantgrowth along the jetty of Derby should perhaps be referred to this formation. The species observed there were: *Cressa cretica*, *Evolvulus alsinoides* (var. *sericeus*), *Neptunia monosperma*, *Trianthema crystallinum* and *Boerhaavia diffusa*.

### 3. The Salt-Pan Formation.

In depressions and low-lying sandy flats near the coast an open vegetation of halophilous succulent perennial herbs is to be found. This was well developed in depressions at Port Hedland between the town itself and its harbour (Plate II, Fig. 1). The dominating plants were cushion-forming Chenopodiaceæ: *Arthrocnemum leiostachyum*, *A. Benthami*, *A. arbuscula* and *Atriplex exilifolia*. The two first named formed coarse, flat cushions, while *A. arbuscula* was more slender, and its cushions more dome-like; *Atriplex* again, was a semi-globose low undershrub. Together with them grew *Heliotropium curassavicum* in half-buried large specimens, *Trianthema turgidifolium* with its nearly globose leaves and white flowers, *Frankenia ambita*, and a few plants of *Eragrostis Dielsii*.

[1] At Carnarvon, south of the Capricorn, *Salsola Kali* and *Ptilotus (villosiflorus?)* also occurred at the sandy sea-shore.

An analogous formation occurred at Point Samson just above the mangrove. The plants recorded from this locality were *Arthrocnemum leiostachyum*, *Frankenia ambita* and *Trianthema turgidifolium*.

I add a list of plants from a salt-pan formation at Carnarvon, south of the Capricorn, as its composition and appearance were very like what is said above. The lower zone consisted of a glaucous, long-branched *Salicornia australis* and the aphyllous *Limonium* (*Statice*) *salicorniaceum;* at the higher level, three dark-green *Arthrocnemum*-undershrubs (*A. arbuscula*, *A. brachystachyum* Pauls. and *A. pruinosum* Pauls.) were predominant; *Salicornia* had thrown off its ripe fruits, while the *Arthrocnemum*'s were with flowers and fruits. Other plants were the aphyllous *Samolus junceus*, *Frankenia pauciflora*, a grass and some small Chenopodiaceæ.

The enumerations given are all characterized by the succulent perennial herbs, many of which are aphyllous, and copious hairiness does not occur in any species.

To this formation rather than to the sand-dune formation I reckon two real shrubs, viz. the glaucous *Nitraria Schoberi*, which I saw at Carnarvon, and the bright-green *Myoporum acuminatum* (var. *angustifolium*) which grew both at Carnarvon and at Point Samson.

### 4. The Sand-Dune Formation.

The dunes nearest to the sea were covered by the large grass *Spinifex longifolius*, which was seen at all the places visited (except Derby, where I had no opportunity of seing sand-dunes). The big globular spiny inflorescences loosen at maturity from the straw, and are rolled by the wind over the bare sand; in sheltered places one finds them blown together in quantities. No doubt the wind acts as chief agent in the dispersal of this species.

At some little distance from the sea the dune plants become much more numerous. Amongst the different species of grasses I may mention *Triodia pungens* and others. Several annuals were also seen, but as the season was very unfavourable for these ephemeral plants, I am not able to give any information as to them. An interesting feature of the dune-formation is that the shrubs play a great rôle in its composition. At Point Samson the silver-felted *Scævola sericophylla* with small whitish flowers was common; at Port Hedland the characterising species was a low Wattle (*Acacia Wickhamii*), and at Broome other Wattles (*Acacia holosericea* and *A. binervosa*).

From Carnarvon we have a description of the dune-vegetation by DIELS (l. c., p. 292) which agrees well with what I saw (see Plate II, Fig. 2). The common shrubs were *Scholtzia leptantha*, *Acacia spodiosperma* (bright green), *A. coriacea* (silver-grey), *Atriplex rhagodioides*, *Rhagodia baccata*, *Brachycome latisquamea* and the more herbaceous *Pityrodia petiolaris*, and some species not in flower.

In contrast to the salt-pan plants, the dune plants show their xeromorphy in leathery and glossy leaves, in rolled leaves (the grasses), and in densely clothed (felty) leaves, not in succulent leaves nor in aphylly.

### 5. The Savannah Forest Formation.

During my short visits at the ports of the tropical W. A. I met only one non-halophilous plant-formation, viz. the savannah forest at Derby and (in poorer appearance) at Broome. At the latter place I saw only what was left of it inside the area covered by the township itself, and it was mixed up with introduced species.

The indigenous woody plants noted at Broome were *Gyrocarpus americanus* (var. *acuminatus*), *Bauhinia Cunninghamii*, *Carissa lanceolata*, *Eucalyptus clavigera* (var. *Dallachyana* ?), *E. dichromophloia* and the low shrub *Psoralea Martini*, while the few *Adansonia*'s (*A. Gregorii*) were said to have been planted. Amongst the foreign plants *Poinciana regia* was the most conspicuous, but in gardens (often artificially watered) grew *Nerium Oleander*, *Cocos sp.*, *Bambusa sp.*, *Vinca rosea* etc.

The savannah forest at Derby was more undisturbed by man, still it was not quite virgin. I saw it at a time of the year when the herbaceous undergrowth had quite disappeared owing to the drought. Had I come a few weeks later, when the rain had begun, I should also have been able to study the herbs and grasses. Now only some withered straw and leaves reminded one of the existence of an undergrowth which at times covers the fine red dusty soil. I was forced to content myself with observing the trees and shrubs alone.

More prominent than anything else was the big *Adansonia Gregorii* with its grotesque thick trunk, which has gained it the popular name of "The Gouty Stem" (Plate III, Fig. 2). In the first days of November the trees were mostly leafless, and ornamented only by masses of ripe fruits, but some had new leaves — at least on parts of their crowns — and had just begun flowering; the shedding of the leaves is thus not coincident in all

individuals, nor on all branches of one and the same individual. This *Adansonia* is the characterising tree of the savannah forest of the north-western Australia and gives it a resemblance to the African savannah forest, in which *Adansonia digitata* is the prominent feature.

Also from a plant-geographical point of view its existence is interesting, as the genus *Adansonia*, with this single exception, is confined to tropical Africa including Madagascar. On the African continent only *A. digitata* occurs, and it is an open question whether it owes its ocurrence there to the inhabitants (the negros etc.) or is really spontaneous; but in Madagascar the genus has several species besides *A. digitata.* This distribution suggests that the genus has had its real home in Madagascar or, better, on the sunken continent of which Madagascar is a remainder, and that it has from there outposts both towards east, where *A. Gregorii* arose in tropical North-Australia, and towards west, where *A. digitata* invaded tropical Africa.

Next to *Adansonia* the white-barked "Gums" (*Eucalyptus clavigera* var. *Dallachyana* and *E. pyrophora*) were common. *E. clavigera* var. *Dallachyana*, which was the commoner, had long pendulous outer branches which were moved by the wind. *Gyrocarpus americanus* (var. *acuminatus*) and *Bauhinia Cunninghamii* were also common. *Gyrocarpus* is a low tree with a soft wood and thick, light bark; its leaves are much like those of poplar, and it its a deciduous tree which had just got new leaves at the time of my visit. Its peculiar fruits, with the two long wings (see Fig. 5), resemble very much the fruits of the Dipterocarpaceæ. *Bauhinia* is a low tree with densely branching, dense dark-green foliage and large red-brown pods. Other trees were: *Ficus indecora*, *Santalum lanceolatum*, *Phyllanthus reticulatus* (var. *glaber*), *Atalaya hemiglauca*, *Careya australis*, *Hakea* sp., *Acacia* sp. The vine-like *Tinospora smilacina* was often seen climbing in the trees, and several *Loranthus*-species (see p. 14) infested the trees (noted on *Adansonia*, *Eucalyptus*, *Ficus* and *Hakea*).

The trees stand with open spaces between them, like the trees of a park (see Plate III, Fig. 1), and leave no shade. They do not reach to any considerable height. Some of them are evergreen (*Eucalyptus*, *Atalaya*, *Hakea*, *Bauhinia* etc.), others are deciduous (*Adansonia*, *Gyrocarpus*) and are leafless during the dry winter-time. The evergreen species have, of course, xerophytic leaves, but the xeromorphy consists mainly in leathery consistence, not in coverings of hairs nor in succulence.

## II. List of the Species collected.

In the following list I enumerate all the species which I have collected during my short stays at the different places. This list is of course very incomplete, and does not in any respect pretend to give a full impression of the flora.

It was rather difficult for me to identify the plants, as the material at my disposal for comparison was very poor, and I was not able, under the present circumstances, to visit the large herbaria of Kew and London. Nevertheless I trust that the identifications will in most cases prove to be correct, and I think that the notes under many of the species may be useful for later workers on the flora of the tropical Western Australia.

I have arranged the natural families according to ENGLER's Syllabus der Pflanzenfamilien, 7. ed., 1912.

**Gramineæ.**

**Eragrostis Dielsii** Pilger, in Engl. Botan. Jahrb. 35 (1904) 76; Domin, Beitr. Fl. u. Pfl. Geogr. Austral. I. 2 (1915) 391; *E. falcata* Benth. Fl. Austr. VII (1878) 649, non Gaudichaud.

Port Hedland, in dune depression near the coast (No. 1140, 3. Nov. 1914).

The specimens collected seem to agree rather well with the var. *sciurus* Domin (l. c., 392), but I have no authentic specimen for comparison.

**Triodia** sp., *T. pungenti* R. Br. affinis.

Point Samson (Cossack), the characterising grass on a sandy dune-like area, growing together with *Scævola sericophylla*.

The specimens collected (No. 1139: 2. Nov. 1914) — and all specimens seen — were past flowering and fruiting, and the panicles contain mostly only empty outer glumes, rarely the lowermost flower, and in no case a whole spikelet. The identification is therefore only approximative.

**Spinifex longifolius** R. Br., Prodr. Fl. Nov. Holl. (1810) 198; Benth. Fl. Austr. VII (1873) 504.

Point Samson (near Cossack) and Port Hedland, common on the dunes near the shore.

**Moraceæ.**

**Ficus indecora** Miquel in Hook. Lond. Journ. VII (1848) 426; *F. orbicularis* Benth. Fl. Austr. VI (1873) 175, ex parte.

Derby, a shrub or small tree with deciduous leaves (Nos. 1176 and 1177, 7. Nov. 1914, hardly yet in full leaf).

The small-leaved *Ficus* which I have collected at Derby (in two slightly different forms), belongs to the collective species *F. orbicularis* A. Cunn., as limited by Bentham (l. c.). But as far as the descriptions go, my specimens agree better with *F. indecora* Miq., than (1) with *F. orbicularis* in the original narrower sense (as given by Miquel, l. c.), or (2) with *F. Beckleri* Miq. (Journ. Bot. Neerl. 1861, 241), and as the reasons for uniting these three species into one are not quite convincing, I prefer to use Miquel's name.

**Santalaceæ.**

**Santalum lanceolatum** R. Br. Prodr. Fl. Nov. Holl. (1810) 356; Bentham, Fl. Austr. VI (1873) 214; W. V. Fitzgerald, in Journ. Muell. Bot. Soc. II (1903) 66.

Derby, in the savannah forest (No. 1180, 7. Nov. 1914). A small tree with flexible and pendulous young branches and glaucous leaves.

**Loranthaceæ.**

As I was not quite sure that my determinations of the *Loranthaceæ* were correct, I sent specimens of the different numbers to Professor A. Engler of Berlin, the well-known authority on this family. He was so kind as to undertake a revision of my identifications, which appeared to agree wholly with his views, and I use this opportunity to thank him for his kind assistance.

**Elythranthe Exocarpi** (Behr) Engler, in Nachträge zu Engler u. Prantl, Natürl. Pflanzenfam. (1897) 126; *Loranthus Exocarpi* Behr, Linnæa XX (1848) 624; Bentham, Fl. Austr. III (1866) 392.

Broome, common on *Acacia binervosa* (No. 1160, 5. Nov. 1914), in full flower, and with some ripe fruits.

**Loranthus acacioides** A. Cunn., in Benth. Fl. Austr. III (1866) 392.

Derby, common on *Adansonia Gregorii* (No. 1183, 7. Nov. 1914), all specimens in flower. It does not grow on Acacia, as might be thought from the name, which, however, relates to the likeness of the plant to an Acacia.

**Loranthus bifurcatus** Benth., Fl. Austr. III (1866) 393.

Derby, common on *Eucalyptus clavigera* var. (No. 1181, 7. Nov. 1914); a very characteristic species, with young (unripe) fruits.

**Loranthus quandang** Lindl. in Mitch. Three Exped. II, 69; quoted from Bentham, Fl. Austr. III (1866) 395.

Derby, specimens with young buds only (No. 1182, 7. Nov. 1914). The host plant was not noted. The specimens have unusually broad and short leaves (broadly elliptic).

**Chenopodiaceæ.**

Dr. Ove Paulsen is publishing a separate paper on my *Chenopodiaceæ* from West Australia, see p. 56.

**Amarantaceæ.**

**Ptilotus villosiflorus** F. v. Müll., Fragm. Phytogr. Austr. III (1863) 125; Benth. Fl. Austr. V (1870) 245; E. Cheel, in K. Sv. Vet. Akad. Handl. 52, No. 10 (1916) 7.

Port Hedland, near the shore (3. Nov. 1914).

Both at Port Hedland and, south of the Tropic of Capricorn, at Carnarvon and Geraldton a small *Ptilotus* was common in the dune depressions near the shore. It agrees well with the above quoted species which E. Cheel (l. c.) records from Port Hedland. But I think that the *Ptilotus* species of the warmer parts of Australia require a thorough revision.

**Gomphrena pusilla** Benth. Fl. Austr. V (1870) 256.

Nullagine Distr. (I. T. Tunney, June 1901, ex herb. Mus. Perth).

From the botanical collection of the Museum at Perth I obtained — amongst several herbarium sheets from the southwestern part of W. A. — an undetermined *Gomphrena* ("*Ptilotus*"), which I refer to *G. pusilla* Benth., a species which comes near to *G. Maitlandi* F. v. Müller.

**Nyctaginaceæ.**

**Boerhaavia diffusa** L., Fl. Zeylan. (1747) 4; Benth., Fl. Austr. V (1870) 277, ex parte.

Derby, on the jetty, a prostrate white-flowered weed (No. 1170, 7. Nov. 1914).

The specimens collected agree well with specimens in our herbarium in Copenhagen named *B. diffusa* L. by Heimerl, the authority on *Nyctaginaceæ*. They differ in some points (of minor importance ?) from specimens named *B. procumbens* Roxb. More widely different (e. g. by the much longer pedicels) is *B. mutabilis* R. Br., if Preiss's No. 2389 from Swan River is to be taken as typical for that species.

**Aizoaceæ.**

**Trianthema crystallinum** Vahl, Symbol. I (1790) 32 et in D. C. Prodr. III, 352; Benth. Fl. Austr. III (1866) 330.

Of this variable species (or aggregate of species) a form with long, linear, semiterete leaves was found along the jetty at Derby (No. 1173, 7. Nov. 1914). Another form was collected in a dune depression at Port Hedland (No. 1152, 3. Nov. 1914); it has oblong-linear succulent leaves. (Both determined by Dr. O. PAULSEN).

**Trianthema turgidifolium** F. v. Müll., Fragm. Phytogr. Austr. X (1876) 83.

This interesting succulent species was well described by F. v. MÜLLER (l. c.) upon specimens collected "in plagis sinum Nichol's Bay versus" by M. CROUCH. From the same area, Point Samson (near Cossack) I have brought home specimens (No. 1153, 2. Nov. 1914) which agree well with Müller's description.[1] The leaves are very succulent, globose-clavate, downwards attenuated into a short petiole (see Fig. 4). The flower is whitish, sepals long-triangular, acute, stamens 10 with red-brown anthers, ovary nearly globose with one somewhat excentric filiform style; the membranous capsule contains several seeds (somewhat more than "circiter 5", as F. v. Müller says).

Fig. 4. *Trianthema turgidifolium* F.v. Müller. A branch with flowers.(Nat.size).

The species has, as pointed out by F. v. Müller, a striking resemblance to small-leaved succulent forms of *Sesuvium portulacastrum*, and I must admit that I think the two genera ought to be united, or *Trianthema* split up into several genera; the present delimitation at least is very artificial and unsatisfactory.

*T. turgidifolium* was found inside the mangrove in a salt-pan together with Frankeniæ and Salicorniæ.

In F. v. MÜLLER's 2nd Census (p. 52) the species is given for S. A., Q. and N. A., not for W. A., but there must be some mistake here (printer's error ?) as Nichols Bay is in W. A., and it is doubtful if the species has been recorded from other states.

**Menispermaceæ.**

**Tinospora smilacina** Benth., Journ. Linn. Soc. V, Suppl. II (1861) 2; Fl. Austr. I (1863) 55; Diels, Menisperm. in Das Pflanzenreich IV (1910) 136.

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[1] I have also noted it from Port Hedland.

Derby, in the savannah forest (No. 1179, 7. Nov. 1914). A coarse climber found climbing in *Bauhinia Cunninghamii* and many other trees. The ripe drupes are orange-red.

**Hernandiaceæ.**

**Gyrocarpus americanus** Jacq., Select. Amer. (1763) 282, tab. 178 fig. 80, emend.; F. v. Müller, Sec. Cens. Austr. Pl. (1889) 87; *G. Jaquinii* Roxb. Corom. I (1795) 2, tab. 1; Benth. Fl. Austr. II (1864) 505; W. V. Fitzgerald, in Journ. Müll. Bot. Soc. III (1903) 24, et aliis; *G. acuminatus* Meissner in D. C. Prodr. XVI (1864) 248.

Broome, a rather low tree with light-coloured bark and light wood (No. 1161, 5. Nov. 1914).

Derby, a rather low tree with light-coloured bark and soft wood, in full flower and with ripe fruits (see Fig. 5) and even fully developed new leaves (No. 1174, 7. Nov. 1914).

The monotypic *Gyrocarpus* is usually called *G. Jacquinii* Roxb. which name was created to include all the hitherto described forms, as it was suggested that they all belonged to one species; but as the name *G. americanus* Jacq. is the oldest, it must be preferred to all the others, as correctly done by F. v. Müller (Sec. Census., 87).

The specimens collected both at Broome and at Derby agree in the nearly glabrous leaves, which are entire, broadly cordate and distinctly acuminate. If we choose to divide the species into subspecies, they may be named subsp. *acuminatus* Meissn. (l. c.); they seem to differ considerably from the two Australian forms described by R. Brown (Prodrom. Fl. Nov. Holl. 405) the leaves of which are tomentose, at least on the underside.

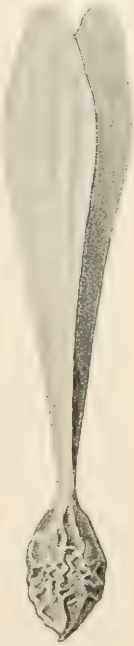

Fig. 5. *Gyrocarpus americanus* Jacq. A ripe fruit from Derby. (Nat. size).

In E. Cheel's paper (Plants, in Results of Dr. E. Mjöberg's Swedish sc. Expeditions to Australia 1910—13, K. Svenska Vet. Akad. Handl. Bd. 52, No. 10, 1916, pl. I, figs. 3—4) two photos from the Kimberley region, taken by Dr. Mjöberg, illustrate *Gyrocarpus*, the so-called "cork-tree" (on account of the spongy bark), in leafless and leafy stage; they give a very good impression of its general habit.

**Capparidaceæ.**

**Cleome tetrandra** Banks, in D. C. Prodr. I (1824) 240; Bentham, Fl. Austr. I (1863) 90.

Port Hedland, in flower (flowers yellow) and with young fruits (No. 1141, 3. Nov. 1914).

**Leguminosæ.**

**Acacia holosericea** A. Cunningh. in G. Don. Gen. Syst. II (1832) 407; Bentham, Fl. Austr. II (1864) 411; *A. neurocarpa* A. Cunningham, in Hook. Icon. pl., tab. 168.

Broome (No. 1135, 5. Nov. 1914), a tall shrub, very common. The numerous spirally twisted pods are brown; seeds obovate, somewhat flattened, shining black; funicle folded, orange-yellow.

**Acacia Wickhamii** Benth., in Hooker, London Journ. Bot. I (1842) 379; Fl. Austr. II (1864) 392; F. v. Müller, Iconogr. Austr. Acacia XI, tab. 6.

Port Hedland (No. 1134, 3. Nov. 1914), a low shrub, very common. The ripe pods are light-brownish, veined, straight; seeds ovate, pale brownish; funicle pale.

**Acacia binervosa** D. C., Mem. Legum. XII 448 (1825); *A. bivenosa* D. C. Prodrom. II (1825) 452; Bentham Fl. Austr. II (1864) 380; W. V. Fitzgerald, in Journ. Müll. Bot. Soc. II (1903) 18. (Determ. J. H. Maiden).

Broome (No. 1133, 5. Nov. 1914), a medium sized shrub. The ripe pods are light brown, moniliform, but flattened and with thickened margins; seeds somewhat flattened, broadly ovate, shining black; funicle orange-red, much folded.

**Neptunia monosperma** F. v. Müll., in Bentham, Fl. Austr. II (1864) 300.

Derby: on the jetty (No. 1172, 7. Nov. 1914). A decumbent herbaceous plant with pale inconspicuous flowers aud orbicular coin-like pods.

**Bauhinia Cunninghamii** Benth., Fl. Austr. II (1864) 295; W. V. Fitzgerald in Journ. Müll. Bot. Soc. II (1903) 14; *B. Leichhardtii* F. v. Müll., Transact. Victorian Inst. III (1858) 50; Sec. Census, Austr. Pl. (1889) 73; *Phanera Cunninghamii* Bentham, in Miquel, Pl. Junghun. I (1851) 264.

Broome (No. 1157, 5. Nov. 1914) and Derby (No. 1178, 7. Nov. 1914); in both places with ripe pods. A rather low tree

with clustered branches and dense foliage, which give it a singular appearance. A good photo of its habit was taken by Dr. E. Mjöberg and published by E. Cheel (K. Svenska Vet. Akad. Handl., Bd. 52, No. 10, 1916, pl. I, fig. 2).

It was common in the savannah forest at Derby and often infested by the climber *Tinospora smilacina*. The somewhat curved and flat brownish pods contain 2—7 seeds. The seeds are flat, oblique-ovate, dull chestnut-brown, 13—16 mm long and 10—12 mm broad.

**Crotalaria Cunninghamii** R. Br., in App. Sturt Exped. (1849) 8; Bentham, Fl. Austr. II (1864) 182; Hooker, Icon. pl., tab. 829.

The well-known "Bird-flower" of the inhabitants (from the likeness of the flower to a bird) was found in full flower and, on the same individuals, with ripe fruits at Port Hedland (No. 1147, 3. Nov. 1914). It is a shrub or undershrub of medium size.

**Crotalaria trifoliastrum** Willd. Sp. pl. III (1800) 983; Bentham, Fl. Austr. II (1864) 183; *C. medicaginea* F. v. Müller, Fragm. phytogr. Austr. III (1862) 56, ex parte; vix Lamarck.

Broome (No. 1159, 5. Nov. 1914), in flower and fruit; an erect herb or undershrub.

I agree with Bentham (l. c.) in keeping *C. trifoliastrum* Willd. apart from *C. medicaginea* Lam., with which F. v. Müller (l. c.) has united it. My specimens are much like Indian *C. trifoliastrum* and very different from Indian *C. medicaginea*, which is a decumbent (prostrate) herb with smaller flowers, etc.

**Psoralea Martinii** F. v. Müll., Fragm. Phytogr. Austr. V (1865) 11.

Broome (No. 1162, 5. Nov. 1914), in flower and with fruit; an erect shrub or undershrub.

F. v. Müller (l. c.) described this very characteristic species from a single specimen without ripe fruits. As I have had good material at hand and have grown the species in the Botanical Garden of Copenhagen from seeds taken at Broome, I am able to give an additional description of the flowers and fruits:

Planta suffruticosa, undique albo-tomentosa, præsertim in pedicellis et calycibus; floribus 3—6, umbellatis. Calycis lacinii inæquales, infimo distincte longiore; corolla parva lilacina, glabra; petalum supremum ovato-rotundatum, emarginatum, breviter unguiculatum, parte centrali lilacina (CC.[1] 511—506), partibus periphericis atque superficie tota externa pallide lilacinis (CC. 0496);

[1] CC = Klincksieck et Valette, Code des Couleurs, Paris 1908.

petala lateralia et inferiora in supremis partibus lilacina (CC. 511—506), spathulata, unguiculata. Filamenta staminorum glabra, antheræ parvæ, ovato-cordatæ. Stylus curvatus, filiformis, glaber; germen parce pilosum præsertim apicem versus. Legumen maturum parvum calyce duplo vel ultra brevius, oblique-ovoideum, ca. 4 mm longum, atrofuscum, tomento albo præsertim apicem versus præditum. Ceterum ut in descriptionem a F. Muellero datam.

The species was first found near Glenelg's River, Kimberley (ca. 124°30′ Long. E, 15°50′ Lat. S.) and now at Broome somewhat farther southwards.

### Zygophyllaceæ.

**Tribulus cistoides** L. Sp. pl. (1753) 387; Bentham, Fl. Austr. I (1863) 288.

Port Hedland (No. 1155, 3. Nov. 1914). A decumbent yellow-flowered herb.

As I have no access to the description of *T. Forrestii* F. v. Müll. (in Wing's S. Sc. Rec. Nov. 1885), and as my only specimen has no fruit, I have given it under the old collective name *T. cistoides* L.

### Euphorbiaceæ.

**Excoecaria agallocha** L. Sp. pl. ed. 2 (1763) 1451; Benth. Fl. Austr. VI (1873) 152; F. Pax, Euphorbiaceæ-Hippomaneæ, in Das Pflanzenreich (1912) 165.

Derby, a small tree in the mangrove (No. 1164, 7. Nov. 1914).

Amongst the *Avicennia's* which make up the main part of the mangrove at Derby near the jetty, single specimens of a small tree with dark green and shining leaves occurred. As I only could get specimens without any flower and fruit, I was not able to refer the plant to its proper place. But at my request, Professor V. A. Poulsen of Copenhagen examined the structure of the leaves and suggested that it might be a species of *Excoecaria*, owing to its extrafloral glands at the base of the leaf-blade and to the milk vessels. This led me to identify it as a variety of *E. agallocha* answering well to the var. **ovalis** (Endl.) Müll. Arg. (D. C. Prodr. XV. 2 (1866) 1221), according to the description of this given by Pax (l. c.): Folia suborbicularia vel orbiculari-obovata, apice rotundato-obtusa.

This variety — as well as the main species — are both known

from North Australia and Queensland. Whether the variety is or is not really an independent species is another question.

**Phyllanthus reticulatus** Poir., var. **glaber** Müll. Arg. in D. C. Prodr. XV. 2 (1866); Benth. Fl. Austr. VI (1873) 101.

Derby, a shrub with flowers and unripe fruits (No. 1165, 7. Nov. 1914).

The distinctions given by BENTHAM (l. c.) between the glabrous variety of *P. reticulatus* Poir. and *P. baccatus* F. v. Müll. are not very sharp, and my specimens agree in some respects with the latter species. But as the flowers — both male and female — have short filiform pedicels longer than the perianth, and as the filaments of the stamens are more or less united, I prefer to place my specimens under the widely distributed *P. reticulatus*, of which, no doubt, several geographical races will be distinguished in future.

**Sapindaceæ.**

**Atalaya hemiglauca** F. v. Müll., in Benth., Fl. Austr. I (1863) 463; W. V. Fitzgerald, in Journ. Müll. Bot. Soc. II (1903) 12. (Determ. J. H. MAIDEN).

Derby, in the savannah forest (No. 1166, 7. Nov. 1914). A small tree without flowers.

**Tiliaceæ.**

**Corchorus Walcottii** F. v. Müll., Fragm. Phytogr. Austr. III (1862) 9; Bentham, Fl. Austr. I (1863) 278.

Port Hedland (No. 1151, 3. Nov. 1914). A small densely tomentose undershrub, in full flower.

**Malvaceæ.**

**Abutilon flavum** sp. nov. (Fig. 6).

Herba basi sublignosa, undique dense stellato-tomentosa; caulis ramosus pedalis et ultra, insuper — atque petioli pedunculique — pilis simplicibus patentibus instructus; stipulæ parvæ lineares, mox deciduæ; petioli 2.5—3 cm longi; foliorum laminæ ovato-cordatæ, acutæ, 3—4 cm longæ, 2—4 cm latæ, marginibus regulariter crenato-serratis, supra dense stellato-tomentosæ, subtus dense albo-stellato-velutinæ nervis prominentibus, sine pilis longioribus (marginibus exceptis). Flores racemosi, foliis parvis instructi (ut in *A. aurito*): pedunculi 2—2.5 cm longi, in parte superiori articulati; calyx 0.7—0.8 cm longus, 5-lobatus lobis obovato-

triangularibus acutis; petala 2—2.5 cm longa, flava; stamina flava; fructus calyce dimidio vel subduplo longior, truncatus, 1.0—1.2 cm longus; carpellæ 10, dense stellato-tomentosæ, apice contractæ, rostro brevi divergenti instructæ; semina ca. 3 in carpella, subreniformia, brunneo-purpurea, ca. 2 mm in diametro.

Hab. Austr. occid. trop. ad Derby, W. Kimberley.

Ab *A. aurito* (Wall.) Don præcipue differt: calyx, carpellæ et folia dense stellato-tomentosa sine pilis simplicibus longioribus; corolla calycem triplo superans; carpellæ 10, calyce subduplo longiores rostro brevi divergente instructæ; ab *A. indico* (L.) Sweet: inflorescentia racemosa, foliis parvis instructa; caulis, petioli pedunculique præter tomentum pilis longioribus simplicibus; foliorum margines dense et regulariter crenato-serrati; carpellæ ut supra descriptæ.

Fig. 6. *Abutilon flavum* nov. sp. Part of a branch with a nearly ripe fruit. (Nat. size).

Near the jetty at Derby I found a yellow-flowered *Abutilon* (No. 1171, 7. Nov. 1914) which does not agree with any species described, as far as I know. It comes nearest to *A. indicum* (L.) Sweet (sens. lat., incl. var. *australiense* Hochr.) and *A. auritum* (Wall.) Don, but the above given description and the differences pointed out will show that it is quite distinct. Also from the Australian *A. longilobum* F. v. Müll., *A. otocarpum* F. v. Müll. (with its var. *broomensis* Hochr. from Broome) and *A. oxycarpum* F. v. Müll. it seems well separated, as far as can be judged from descriptions without access to any authentical specimens.

**Bombacaceæ.**

**Adansonia Gregorii** F. v. Müll., in Hooker, Kew misc. IX (1857) 14; Benth. Fl. Austr. I (1863) 223; W. V. Fitzgerald, in Journ. Müll. Bot. Soc. III (1903) 5; *A. Stanburyana* Hochreutiner. in Ann. Conserv. et Jard. botan. de Genève, 11—12 Ann. (1908) 136, pl. I—II.

Broome, a few trees seen (5. Nov. 1914).

Derby, common in the savannah forest, with ripe fruits and some trees with newly out-folded leaves and in flower (No. 1175, 7. Nov. 1914). The flowers were white with a cream-coloured tinge.

There is considerable variability in the characters of this plant. This has induced B. P. G. Hochreutiner (l. c.) to create a new species upon a specimen which grows at Broome near the

police station. The distinguishing marks of his *A. Stanburyana* are given as: leaflets generally 5—6 in number, about 16 cm long, glabrous (while in *A. Gregorii:* 7—9, not exceeding 13 cm, and white-tomentose underneath), and calyx glabrous outside (in *A. Gr.* tomentose); and the tree is not so thick and clumsy as is the case with *A. Gregorii.*

I do not think that these marks suffice for a distinction between two species, as my material from Derby[1] shows that the degree of indumentum is rather variable. In my specimens, the young leaves are stellate-tomentose underneath, but the tomentum disappears when they are full-grown; further, the number of leaflets ranges from 5 to 9; the calyx is tomentose outside in the buds, glabrous in the fully developed flowers. As regards the trunk of the tree, its clumsiness augments with the age of the individual (see Pl. III, Figs. 1—2). For better information on the question I asked Professor A. J. Ewart of Melbourne about the material preserved in the Herbarium of Victoria (Müller's herbarium), and he has informed me as follows: "specimens named by Baron von Müller range from densely hairy to glabrous calyx (outside), hence *A. Stanburyana* of Hochreutiner might be classed a glabrous form or variety, but hardly as a species". This is just my opinion: We have only one species of *Adansonia*, viz. *A. Gregorii* F. v. Müll., in Australia; but as is the case in many other species, it varies much with regards to its indumentum, and the glabrous form may be named forma *Stanburyana* (Hochr.), but is of very small systematical value.

In one other respect the species varies considerably, viz. the shape of the fruits. I saw specimens with ovoid fruits (f. *typica;* see Fig. 7), some thicker and some more slender ($12.5 \times 7$; $10.5 \times 6$; $10 \times 5.5$ cm), but I also met with specimens with completely globose fruits ($6.5 \times 6.7$ cm): f. *globosa* (see Fig. 8); and what is more remarkable, all the fruits of each tree were of the same shape. This fact is known for many European trees or shrubs (e. g. *Quercus* and *Corylus*), and its existence in *A. Gregorii* corroborates Hochreutiner's suggestion (l. c. 142) that the *A. sphærocarpa* Chév. of Madagascar is only a form of *A. digitata* L. with globose fruit, as it agrees with the latter in all other respects.

The fruits of *A. Gregorii* are densely covered with a yellow-brown tomentum which, when rubbed, loosens and gives place to

[1] I only saw, but did not collect the species at Broome, as it was said that the specimens were cultivated from seeds brought from Derby.

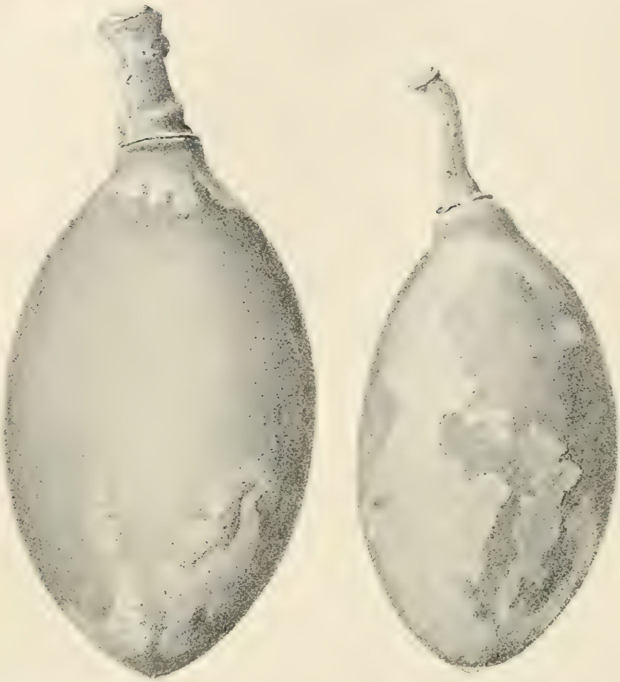

Fig. 7. Fruits of *Adansonia Gregorii* F. v. Müll. f. *typica*, from Derby. ($^3/_5$ nat. size).

the dark-brown, dull and finely granulary surface of the exocarp (see figs. 7—8). This is easily broken — in fact all the fruits blown down by the wind were broken — and the mealy cream-coloured pulp, in which the seeds are imbedded, drops out, — at Derby to be eaten by the goats.

In CHEEL's paper (l. c., Pl. 2, Figs. 1 and 3) two of Dr. MJÖBERG's photos of the species are reproduced, showing a rather tall (Fig. 1) and a very low (Fig. 3) and "gouty" stem.

**Frankeniaceæ.**

**Frankenia ambita** sp. nov. (Fig. 9).

Fruticulus decumbens ramosissimus, caulibus sparse (præcipue sub nodis) setuloso-puberulis, internodiis foliis æquilongis vel plerumque multo longioribus. Folia brevia (3—6 mm longa), brevissime petiolata vel subsessilia, revoluta, glabra, punctata, oblongo-ovata (inferiora), oblonga vel lineari-oblonga, obtusa vel subacuta, opposita, floralia 4-verticillata ovato-triangularia; vagina brevissima, ciliata. Flores in cymis aliquoties dichotomis. Calycis pars inferior plus minus (usque fere dimidio calycis) a vagina communi obconica foliorum floralium

Fig. 8. Fruit of *Adansonia Gregorii* F. v. Müll., f. *globosa*, from Derby. ($^3/_5$ nat. size).

ambita vel cum eadem concreta; pars libera glabra, linearis, 5-nervis, ca. 4 mm longa, foliis floralibus paullo longior. Corolla alba vel pallide-rosea; petala 5 libera, lamina ovato-cordata margine subdentata. Stamina 6, 3 longiora, 3 breviora, medio cohærentia. Styli rami 3; ovula 1—2 in placentis (3) singulis fixa.

Ab omnibus speciebus australiensibus differt: calycis parte inferiori in vagina foliorum floralium occulta.

Hab. Austr. occ. trop.: Port Hedland in depressione inter dunas prope portum (No. 1138, 3. Nov. 1914; typus !); Cossack (L. Diels, Reise in West Austr., No. 2750, 17. Apr. 1901, in Herb. Berol.); Point Samson prope Cossack (No. 1137, 2. Nov. 1914; forma foliis minoribus angustioribus floribusque subsolitariis prædita).

The species of *Frankenia* here described stands near to *F. pauciflora* (as collective species), but it is easily distinguished by the calyx being more or less (sometimes half) imbedded in the obconical sheath formed by the four floral leaves. It differs further

Fig. 9. *Frankenia ambita* nov. sp., from Port Hedland. (1½ nat. size).

in the few (1—2) ovules on the placentas; *F. pauciflora* having several on each placenta. The short and comparatively broad leaves and the paler and smaller flowers are also characteristic.

The Australian (espec. West Australian) Frankenias are a neglected field of investigation, to which I shall return later on when dealing with my plants from the south-western part of W. A. (See pp. 47—55).

**Rhizophoraceæ.**

**Ceriops Candolleana** Arnott, Ann. Nat. Hist. I (1838) 363; Benth. Fl. Austr. II (1864) 436; W. V. Fitzgerald, in Journ. Müll. Bot. Soc. II (1903) 22.

Point Samson (Cossack), mangrove, in full flower and with seedlings ready to drop (No. 1150, 2. Nov. 1914).

The species was common in the mangrove of Point Samson near the jetty; the shrubs were hardly more than the height of a man.

On the whole, the specimens collected agree well with the Asiatic form, especially as regards the three capitate bristles of the petals, but the leaves are smaller and more obovate-spathulate than in the type and the sepals longer and narrower (triangular-linear). As I have not access to other Australian specimens I do not know if these differences are of a general character or only local.

**Rhizophora mucronata** Lam., Encycl. meth. VI (1804) 169; Benth. Fl. Austr. II (1864) 435.

Port Hedland, mangrove (common), in flower and with the seedlings beginning to grow out of the pericarp (No. 1149, 3. Nov. 1914).

**Myrtaceæ.**

**Careya australis** (Benth.) F. v. Müll., Fragm. Phytogr. Austr. III (1866) 183; W. V. Fitzgerald, in Müll. Bot. Soc. II (1903) 48; *C. arborea*, var. (?) *australis* Benth., Fl. Austr. III (1866) 289.

Derby, common in the savannah forest (No. 1184, 7. Nov. 1914). A small tree with rather flexible young branches, with whitish flowers and green fruits.

**Eucalyptus.** The best authority on this difficult genus, Mr. J. H. Maiden, F. R. S., Director of the Botanical Gardens, Sydney, has been so kind as to identify my Eucalyptus, for which I am much indebted to him.

**Eucalyptus clavigera** A. Cunningh., in Walper, Repert. II (1843) 926; Benth. Fl. Austr. III (1866) 250; W. V. Fitzgerald, in Müll. Bot. Soc. II (1903) 43.

var. **Dallachyana** (Benth. l. c., sub. *E. tesselari* F. v. Müll.) Maiden MS.; *E. papuana* F. v. Müll., Descr. Papuan Pl. I (1875) 8.

Derby, a middle sized tree with white bark and flexible pendulous young branches with nearly open flower buds (No. 526, 7. Nov. 1914), common (see Pl. III, fig. 1).

Broome, with flower buds (No. 528, 5. Nov. 1914). This form differs from the specimens from Derby by the scurfy bark of the young flexible branches and by the somewhat broader leaves.

**Eucalyptus dichromophloia** F. v. Müll., Journ. Linn. Soc. III (1858) 89; Benth. Fl. Austr. III (1866) 257.

Broome, with ripe fruits (No. 527, 5. Nov. 1914).

**Eucalyptus pyrophora** Benth., Fl. Austr., III (1866) 257.

Derby, with ripe fruits (No. 525, 7. Nov. 1914).

**Apocynaceæ.**

**Carissa lanceolata** R. Br., Prodr. Fl. Nov. Holl. (1810) 468; Bentham, Fl. Austr. IV (1869) 306; *C. Brownii* F. v. Müll., Fragm. Phytogr. Austr. IV (1863) 45, saltem ex parte.

Broome, (No. 1158, 5. Nov. 1914). A small spiny shrub in full flower (fl. white, fragrant).

**Convolvulaceæ.**

**Cressa cretica** L. Sp. pl. (1753) 223; Benth., Fl. Austr. IV (1869) 437.

Derby, near the jetty, abundant (No. 1168, 7. Nov. 1914). The Australian plant (*C. australis* R. Br.) is distinguished by its large and broad leaves and other characters from specimens of the northern hemisphere.

**Evolvulus alsinoides** L., var. **sericeus** Benth., Fl. Austr. IV (1869) 438.

Derby, sparingly along the jetty (No. 1169; 7. Nov. 1914).

This variety with adpressed white hairs (also on the outer side of the calyx) seems fairly distinct from the common *E. alsinoides*. The flowers are sky-blue. Recorded beforehand from Port Walcott (W. A.) and Islands of the Gulf of Carpentaria.

**Borraginaceæ.**

**Heliotropium curassavicum** L. Sp. pl. (1753) 130; Bentham, Fl. Austr. IV (1869) 393.

Port Hedland, in low-lying parts of sand-dunes near the shore, partly buried by sand (No. 1156, 3. Nov. 1914).

**Verbenaceæ.**

**Avicennia officinalis** L. Sp. pl. (1753) 110; Benth. Fl. Austr. V (1870) 69; R. T. Baker, in Journ. & Proc. R. Soc. of N. S. Wales, XLIX (1916) 257.

Point Samson (Cossack), with young flower buds, very common in the mangrove (No. 1148, 2. Nov. 1914).

Port Hedland, common (3. Nov. 1914); see Pl. I, figs. 2—3.

Broome, common (5. Nov. 1914).

Derby, with young flower buds, very common in the mangrove (No. 1167, 7. Nov. 1914); see Pl. I, fig. 1.

This is the main component of the W. Australian mangrove. It is called "white mangrove" or "grey mangrove". As pointed out by R. T. Baker in his recent monograph of "the Australian Grey Mangrove" the name *A. officinalis* L. covers a great variety of forms.

**Myoporaceæ.**

**Myoporum acuminatum** R. Br., Prodr. Fl. Nov. Holl. (1810) 515; Benth. Fl. Austr. V (1870) 3.

Point Samson (Cossack), a bright-green shrub with white flowers and purple drupes; near the shore (No. 1132, 2. Nov. 1914).

I follow Bentham (l. c.) in his treatment of the many closely allied forms of *Myoporum*. The specimens collected answer well to his var. *angustifolium* Benth. (l. c. 4) = *M. Cunninghamii* Benth. in Hügel, Enum. (1837) 78, which latter name ought to be used as it has the priority.

**Goodeniaceæ.**

**Scævola sericophylla** F. v. Müll., in Bentham, Fl. Austr. IV (1869) 102; K. Krause, Goodeniaceæ in Das Pflanzenreich IV. 277 (1912) 162.

Point Samson (Cossack) (No. 1154, 2. Nov. 1914).

A shrub with unarmed rather long branches and dwarfy rosulate side-branches bearing silver-clothed leaves and the inconspicuous white flowers. It was the dominating species in a sparsely covered sand-dune area near the jetty.

**Compositæ.**

**Pterocaulon sphacelatus** (Labill.) Benth. et Hook. Gen. pl. II (1873) 94; F. v. Müll. Sec. Census (1889) 134; *Monenteles sphace-*

Fig. 1. Mangrove of *Avicennia officinalis*, at Derby; low water, the sea has retired entirely from the mangrove. (7. Nov. 1914). Photo. by C. H. O.

Fig. 2. Mangrove at Port Hedland; high water time, Avicennia's standing in water until the crown. Note: the steamer lying behind the jetty is high on the water. (3. Nov. 1914). Photo. by C. H. O.

Fig. 3. Mangrove at Port Hedland; low water time, Avicennia's free from water. Note: the steamer has sunk behind the jetty. (3. Nov. 1914, taken from the same spot as fig. 36, but 6 hours later). Photo. by C. H. O.

Fig. 1. Salt-pan formation at Port Hedland. Low cushions of *Arthrocnemum* species, higher of *Atriplex elachophyllum*. (3. Nov. 1914). Photo. by C. H. O.

Fig. 2. Sand-dune at Carnarvon: dune depression in the foreground, dune shrubs on the slope. (31. Octob. 1914). Photo. by C. H. O.

Fig. 1. Savannah forest at Derby. *Adansonia Gregorii* (on left) and *Eucalyptus clavigera* var. *Dallachyana* (on right) in the foreground. (7. Nov. 1914). Photo. by C. H. O.

Fig. 2. A big tree of *Adansonia Gregorii* at Derby. (7. Nov. 1914). Photo. by C. H. O.

*latus* Labill., Sert. Austr. Caled. (1824) 43, tab. 44; Benth. Fl. Austr. III (1866) 523.

Port Hedland, a weed (No. 1136, 3. Nov. 1914).

The specimens do not agree fully with the plants of *P. sphacelatus* from Queensland, and I think De Candolle (Prodr. V, 455) rightly described three species under what is now taken as one. But as my specimens are rather poor with regard to leaves owing to the attacks of some "mining" insects, I leave them at present under the old name.

# A Revision of the West Australian Species of Triglochin, Crassula (Tillæa) and Frankenia.

By

C. H. Ostenfeld.

The flora of the extra-tropical region of West Australia — especially that of the south-western part — has been studied by many botanists, and is nowadays well investigated. It is therefore not to be expected that my collection, made in places often visited by collectors, should bring much that is new; and I do not think it worth while to publish a full list of the species of which I have brought specimens home.

Still, when working at the identification of my plants, I find here and there some additions and records which may prove to be of interest, and which I intend to publish later on; and in some cases the examination of my material has brought me into a closer study of groups which seem to have been neglected. When possible, I have then tried to get as ample material for comparison as possible, and have several times succeeded in obtaining sufficient material for a revision of a group or a genus, at least as far as W. A. is concerned. Such has been the case with the three genera *Triglochin*, *Crassula* and *Frankenia*, a revision of which I am publishing here.

I am much indebted to several gentlemen who have procured material for me, as will be acknowledged below. I may especially mention Mr. J. H. Maiden, F. R. S., of Sydney, Professor A. J. Ewart of Melbourne, Mr. J. M. Black of Adelaide and Professor L. Diels af Berlin.

## I. Triglochin (Plate IV).

Besides the larger perennial species — viz. *T. striata* Ruiz & Pav. and *T. procera* R. Br. —, several small annual species of the genus occur in West Australia. As I happened to collect some

of them, I became interested in their systematical relations, which are considered in different ways by different authors.

Through the kindness of Professor A. J. Ewart and Mr. J. H. Maiden I got a good number of duplicates from the rich collections in the National Herbariums of Victoria and New South Wales. I have further had access to the specimens in the Herbarium of Berlin, which have been used by the monographer of the genus, F. Buchenau, and I have examined several sets of Preiss's plants, of which especially the herbarium of Lund, Sweden, has a very good one, with labels written by Nees ab Esenbeck. With exception of the collections in Kew and London I have, I think, in this manner succeeded in inspecting all the more important sources of our knowledge as to these plants, and have seen all the Australian species of the genus, in many cases even specimens from the type collection.

The late F. Buchenau made a careful study of this genus, and has written several papers about it, his last publication being the monograph in "Das Pflanzenreich" (1903), in which he recognizes 6 annual species. Later, two more annual species have been published.

Amongst these species **Triglochin mucronata** R. Br. differs widely from the others by its turbinate fruit with reflexed mucronate carpel-apices; it seems to be common around Swan Riwer and has a wide range in the extra tropical Australia. I found it in plenty near Bayswater (No. 140, 18. Oct. 1914).

All the other annual species are closely related one to another. Bentham (Fl. Austr. VII, 1878) even unites all the then described forms into one species, *T. centrocarpa* Hook., but no doubt Buchenau and F. v. Müller were right in splitting these plants into several species.

*T. centrocarpa* Hook. and *T. calcitrapa* Hook. were published in Icon. pl. VIII (1845) as tab. 728 and 731 respectively. Next year (1846) *T. trichophora* was described by Nees ab Esenbeck in *Plantæ Preissianæ* (II. 1, p. 54). Then follows *T. nana* F. v. Müll. in Trans. Victoria Inst. I (1854) and in Hook. Journ. of Bot. VIII (1856) 332. In 1867 F. v. Müller (Fragm. Phytogr. Austr. VI, 82) gives a new latin diagnosis of his species, explains the differences between the hitherto known species (quoting the nos. of Pl. Preissianæ) and mentions — without any real description — a new species *T. minutissima*. He is much in doubt as to the value of all the species, and writes: Forsan omnes hæ plantæ confluunt.

A few years later F. BUCHENAU (Abhandl. Naturw. Verein Bremen, II, 1871) for the first time makes an elaborate study of the species, clearing up the differences in a very good manner. Later (in Engler's Botan. Jahrb. II, 1882) he comes back to the matter, and has several additions and corrections to make although still in the main at the same standpoint as in 1871. Not much different from this is his monograph of 1903; only he adds a new West-Australian species, viz. *T. Mülleri.*

Since the publication of BUCHENAU's monograph N. E. BROWN (Kew Bull. 1914, 189) has described *T. Stowardii* from Beverley, W. A., and A. J. EWART (Victor. Natur. 23, 1906, 43) raised *T. turrifera* (*T. centrocarpa* var. *turrifera* Luehm.) from Victoria to specific rank.

From my examination of rich material of all these small plants I have arrived at the conclusion that BUCHENAU's delimitation on the whole holds good, and that it is not permitted, as BENTHAM did, to unite them into one "species". But there are some smaller points in which I do not agree with BUCHENAU.

Often two or more species grow together on the same spot, and this has made much confusion, as the older collection numbers sometimes contain more than one species and therefore have been quoted in one way by one author, in another by another; this is specially the case with Preiss's plants.

Such small and simple plants with filiform leaves and small inconspicuous flowers in erect racemes, do not show many distinction marks, and it is, therefore, but natural that all authors have laid stress upon the only more prominent character, viz. the shape of the fruit. In reality we find here very good distinctions between the species, but on the other hand it must be admitted that there is a marked variability, pointing towards the probability that even the now recognized species are collective. Culture experiments will undoubtedly result in the recognition of many micro-species, and it seems that this group of the genus is very polymorphous.

My investigation has led me to keep the following species as distinct:

1. **Triglochin calcitrapa** Hook., Icon. pl. VIII (1845), tab. 731; Buchenau, Pflanzenreich (1903) 12.

This species is easily distinguished by the 3—4,5 mm long, pyramidal-linear fruits with long, curvate basal spurs. The leaves are setaceous-filiform and much shorter than the fruiting scapes. As BUCHENAU (l. c.) has pointed out, some specimens are larger

and have sessile fruits (*α, sessiliflora* Buchenau), others are more slender and have pedunculate fruits (*β, pedunculata* Buchenau, see Pl. IV, Fig. 7). On the whole the species seems somewhat variable.

I have collected it near the Yallingup Cave House (No. 141; 26. Sept. 1914) and have seen specimens from other places in West Australia, as well as from New South Wales and Victoria.

2. **Triglochin Stowardii** N. E. Brown, Kew Bull. (1914) 189.

Of this species I have only seen a poor specimen (Pl. IV, Fig. 11), kindly sent me by Prof. A. J. Ewart. It is part of the type collection. Evidently this species is very close to *T. calcitrapa.* It has the same filiform leaves and the shape of the fruit is not much different; further, the two species have in common the well-developed basal spurs of the fruit and also the even tapering of the fruit from the base towards the apex; but the fruit is much larger and longer (about 15 mm) and more linear, and the curved spur is shorter.

Up to now it is only known from the type locality: Beverley, W. A. (leg. F. Stoward 1913).

3. **Triglochin turrifera** (Luehm.) A. J. Ewart, Victorian Naturalist, 23 (1906) 43; *T. centrocarpa*, var. *turrifera* Luehmann; *T. calcitrapa* Ewart, Victorian Nat., 24 (1907) 60.

I have not had access to the two literature references quoted, but Prof. A. J. Ewart has kindly given them in a letter, and has further sent me specimens so named from Taylor's Creek, Wimmera, Victoria (J. P. Eckert 1898; Pl. IV, Fig. 10), and another specimen of just the same form, but named *T. centrocarpa* from Little Desert, County of Lowan, Victoria (F. M. Reader, 1892; Pl. IV, Fig. 9). These specimens show that Victoria possesses a well marked species which has not hitherto been found outside this state.

No doubt it is related to *T. calcitrapa*, but widely differing by the linear, flaccid leaves and the shape of the fruit. This is short (3,5—4 mm), pyramidal with an abruptly set apical cone, not pyramidal-linear tapering evenly from base towards apex; further the basal spurs are shorter and not curvate.

4. **Triglochin centrocarpa** Hook., Icon. pl.VIII (1845), tab. 728; Buchenau, Pflanzenreich (1903) 13; *T. nana* F. v. Müller, Trans. Victoria Instit. 1 (1854) 135, et Hooker's Journ. of Bot. VIII (1856) 332; Buchenau, l. c., 12.

Buchenau keeps *T. centrocarpa* Hook. and *T. nana* F. v. Müll. as two distinct species, but I must agree with Bentham (Fl. Austr.

VII (1878) 167) that they are connected by a series of forms which makes it impossible to draw a separating line between them, at least not until growing experiments have been tried, and these would probably result in a fair number of distinct micro-species, not in two. Therefore, I do not find it allowable from systematical and phytogeographical points of view to maintain two forms the extremes of which may be discernible, while the main bulk are indiscernible. That Hooker's *T. centrocarpa* is an extreme form, seems probable from the fact that it has not been collected since DRUMMOND's original specimens; while specimens referred to the less sharply defined *T. nana* have often been found.

The supposed distinction marks are: *T. centrocarpa* has appressed, sessile fruits, 3,8—5 mm long, and the backs of the carpels are subcarinate, while *T. nana* has erect, pedunculate fruits, 2—3 mm long, and rounded backs of the carpels.

Now we have in another species, *T. calcitrapa*, specimens with sessile and larger fruits and others with pedunculate and smaller fruits, without separating them into two species, and consequently there is no reason for doing it here. I have myself collected a number of specimens of *T. centrocarpa* at Armadale, near Perth (No. 143, 20. Sept. 1914) which show in some individuals sessile (see uppermost specimen in Pl. IV, Fig. 2), in others pedunculate fruits (see the larger specimens in Pl. IV, Fig. 2), and the back of the carpels varying from carinate to rounded. The length of the fruits is also highly variable, and there seems, usually, to be a correlation in such a manner that the sessile fruit is larger than the pedunculate one.

Neither does the geographical range show any distinction between the forms: I have seen specimens of *T. nana* collected by F.v. MÜLLER himself in Victoria (Station Peak, 1867; Pl. IV, Fig. 4) and they do not differ in any essential point from West Australian ones; neither do Tasmanian specimens collected by R. GUNN and quoted by F. v. MÜLLER (Fragm. VI (1867) 82) differ. Also from South Australia I have seen specimens (see Pl. IV, Fig. 1).

The only two instances in which my examination leaves a little doubt are the following:

(1) var. *brevicarpa* nov. var. (fructus oblongo-linearis, brevis, 2—2,5 mm longus, basi haud calcarata). Some specimens collected by myself at Yallingup Cave (No. 145, 26.—27. Sept. 1914; see Pl. VI, Fig. 3) are rather large, and have shorter and more long-stalked fruits than usual, and the basal spur of the carpels is much less developed than usually in *T. centrocarpa*, where it is

distinct, although very short. This may be an independent species, but at present I prefer to take it as the opposite extreme both to the original *T. centrocarpa* as figured by HOOKER from DRUMMOND's specimens from Swan River district and to the following form.

(2) var. *longicarpa* nov. var. (fructus anguste linearis, 5—5,5 mm longus, basi haud calcarata). A specimen sent from the Nat. Herb. of New South Wales collected by M. KOCH in W. A.: Watheroo Rabbit Fence (9. 1905) is large (11 cm high) and has unusually long and slender fruits (5—5,5 mm), but does not otherwise differ from the usual *T. centrocarpa*.

I characterize *T. centrocarpa* Hook. in the wider sense in the following manner: Small to medium-sized (3—11 cm), leaves setaceous-filiform, much shorter than the scapes; flowers 4—25, sessile or stalked; fruits erect to erect-patent, pyramidal-linear to shortly linear, 2—4 (rarely 5,5) mm long; carpels slightly dilated at the base, with very short basal (not curved) spur and bluntly keeled or rounded back.

The form with nearly sessile fruits and keeled back of the carpels has usually longer fruits (3—4 mm) and their base a little more dilated; it may be named *α*, *typica*. Under this comes var. *longicarpa*.

The form with distinctly stalked fruits and rounded back of the carpels has usually shorter fruits (2—3 mm) and hardly any basal dilation, and for this we may use F. v. MÜLLER's name, calling it *β*, *nana* (F. v. MÜLL. pro sp.). As an extreme of this var. *brevicarpa* may be taken. But as said above, it is in many cases not possible to refer specimens to one form or the other, as they are more or less intermediate.

*T. centrocarpa* is widely distributed from Victoria and Tasmania to West Australia.

5. **Triglochin minutissima** F. v. Müll., Fragm. Phytogr. Austr. VI (1867) 82; Buchenau, Abh. Naturw. Ver. Bremens II (1871) 498; Pflanzenreich (1903) 14.

F. v. MÜLLER writes (l. c.) that he has distributed a *Triglochin* "sub nomine T. minutissimæ": "quæ a formis minimis et gracillimis T. nanæ jam dignoscitur fructibus pertenuibus fere sessilibus. Cum T. nana eam consociatam vidi ad portum Philippi, ad montes Stirlingii, ad flumen Murrayi. Ab hac facillime discerni potest T. trichophora (Nees in Lehm. Pl. Pr. II, 54) jam propter fructum turgidulum separanda; præterea hæc ultima sæpe multo robustior est. Planta Preissii 2409 est T. minutissima". To this

very incomplete description BUCHENAU (1871) has given an amendement and later (1903) a latin diagnosis. This minute plant is characterized by the thin and short (1—1,5 mm), linear, patent, nearly sessile fruits with hardly any basal dilation and with flat or faintly rounded back.

I have seen Preiss's no. 2409 (from Perth) which is quoted both by F. v. MÜLLER and BUCHENAU as *T. minutissima.* It contained two different forms: (1) larger specimens (see Pl. IV, Fig. 12) with very young fruits and slender somewhat bent scapes, evidently young *T. centrocarpa*[1]; (2) minute specimens (see Pl. IV, Fig. 13) with ripe sessile fruits and erect scapes — the true *T. minutissima.*

It seems to be a well marked species. According to F. v. MÜLLER and BUCHENAU, its geographical range extends from Victoria to West Australia, but I have not seen any other specimens than the Preiss'ian ones, and am not sure if it has not been confounded with small and young specimens of *T. centrocarpa.*

6. **Triglochin trichophora** Nees ab Esenbeck in Lehmann, Plantæ Preiss. II, 1 (1846) 54; emendata.

It is with some hesitation that I restore the old name *T. trichophora* Nees, but after having seen specimens of the type collection with NEES's own handwriting on the label I feel convinced to do it.

The species was described by NEES in LEHMANN's *Plantæ Preissianæ* upon Preiss's no. 4211 („in arenoso-conchyliosis humidis prope lacum insulæ Rottennest, 20. Aug. 1839") with the following diagnosis: foliis filiformi-setaceis laxis culmo brevioribus, fructibus erecto-patentibus pedicellatis, oblongo-linearibus trisulcis apice leviter angustatis. In the ensuing description we get the explanation of the singular species-name "trichophora". The author thought to have found hairs ("barba seu coma filorum tenuissimorum") inside the fruit; but, as BUCHENAU (1871, 497) has fully explained, this observation was wrong the supposed hairs being loosened cells of the innerside of the fertile carpels.

BUCHENAU has seen a small specimen of Preiss's No. 2411 and identifies it, "obwohl es keine reifen Früchte besitzt", with *T. nana* F. v. Müll., but on account of the incorrectness of Nees's name

[1] In some collections only sterile specimens with leaf-rosettes are present; they probably all belong to *T. centrocarpa*, at least they can not be referred to *T. minutissima.*

he prefers Mueller's younger name. This question of nomenclature has no interest when we unite *T. nana* with *T. centrocarpa* Hook.

Quite apart from this, however, I think Buchenau was not right in referring *T. trichophora* to *T. nana* (i. e. *T. centrocarpa* sens. lat.). In the herbarium of Lund, Sweden, there is a sheet with the following label: "*Triglochin trichophorum* N. ab E. NB, von mir bestimmt ohne dass ich wusste dass Sie diese Familie bearbeiten, N. v. E." This is written by Nees von Esenbeck to Endlicher who was the author of the other *Alismaceæ* in Lehmann's Plantæ Preissianæ, and consequently the specimens present are authentical *T. trichophora.* They show us a small and slender plant (see Pl. IV, Fig. 6) with setaceous-filiform leaves and with slender, more or less bent scapes. The fruits are not fully ripe, most of them even quite young, and each scape bears very few or only one fruit (Nees writes, in Pl. Preiss., "variat scapo uniflora"). The best developed fruits are rather short (about 2 mm), oblong, and differ in essential points from those of *T. centrocarpa.* F. Müller (1867, 82, quoted above) very appropriately writes "fructum turgidulum". In reality the fruit is shorter and thicker than in the foregoing species. It resembles *T. turrifera*, but differs by the smaller dimensions and the very short basal spurs and the shorter apical part.

Preiss's specimens are rather poor and incomplete, and very likely those seen by Buchenau were quite insufficient to show the distinction from *T. nana*; but from those in the Herbarium of Lund it appears evident that F. v. Müller was right in separating it from his species.

This view is further supported by a *Triglochin* which I have collected in a dune-pan near Busselton (No. 144, 30. Sept. 1914) and which I identify with Preiss's plant from Rottnest Island; it is much better developed (see Pl. IV, fig. 5) and with ripe fruit, and differs only from Preiss's specimens in the straight scape bearing several (up to 17) fruits; the shape of the fruit is the same, and this is the main point.

Upon Nees's original plants and upon mine I have based the following short description: A small, until 8 cm high annual; leaves setaceous-filiform, much shorter than the scapes; scapes erect or ascending, with 1—17 stalked flowers; fruits erect-patent, short (2—2.5 mm), when ripe oblong-ovoid, tapering into a conical apex; back rounded and basal spurs very short, but distinct.

The species seems to prefer the coastal region, as it has been found on Rottnest Island off Freemantle on coral-sand and at

Busselton in a dune-pan. It is distinct from *T. centrocarpa* sens. lat., but very close to the following species, which perhaps is only an extreme form of it.

7. **Triglochin Muelleri** Buchenau, in Das Pflanzenreich, IV, 15 (1903) 12.

In 1882 BUCHENAU (l. c. 509) mentioned a *Triglochin* collected by OLDFIELD at Vasse River, W. A., and sent to him by F. v. MÜLLER, but it was not until 1903 that he, in his monograph, described it. To Prof. A. J. EWART I am indebted for a part of the type collection. The plant in question (see Pl. IV, Fig. 8) is somewhat larger and coarser than the other species, as far as possible to judge from the rather incomplete specimens. The leaves are flaccid-filiform; the scapes, according to BUCHENAU, up to 10 cm high, somewhat curved. They bear many, rather distant flowers. The flowers and fruits are sessile or nearly so, and the fruits (not fully ripe) are ovoid or elliptical, hardly 2 mm long; they have rounded backs, a very minute apical part, and no basal spur at all.

The species is only known from the type collection, and from specimens collected at Busselton by F. STOWARD (Nov. 1912) and sent me from the Nat. Herb. of New South Wales (exactly resembling the type). Perhaps further investigations will, as said above, result in its being united with *T. trichophora.* The geographical range of the two species seems to be the same (Vasse River is not far from Busselton).

The here given revision of the annual species of *Triglochin* accepts 7 species, besides *T. mucronata.* All occur in West Australia with the exception of *T. turrifera.* West Australia further harbours *T. striata* Ruiz et Pav. and *T. procera* R. Br., both of which seem to be common in the S. W. part of the state. Thus it has 9 species of the genus.

The following key gives a synopsis of the differences between the annual species:

A Key to the Annual Species of Triglochin.

*A.* Carpels with free apex, the three fertile ones with a reflexed apical mucro; fruit turbinate .............................. T. mucronata.

*B.* Carpels united up to apex; no apical mucro; fruit linear or pyramidal to ovoid.

*a.* Carpels with well developed, mostly incurved basal spurs: fruit linear-pyramidal or pyramidal.

*α.* Fruit linear-pyramidal, evenly tapering from base towards apex; basal spurs incurved.

*1.* Fruit 3—7 mm long, with rather large basal spurs. T. calcitrapa.
*2.* Fruit about 15 mm long, basal spurs comparatively small. T. Stowardii.
*β.* Fruit pyramidal with a conical apex, 3.5—4 mm long; basal spurs not incurved .............................. T. turrifera.
*b.* Carpels with very short or hardly any basal spurs; fruit linear to elliptic or ovoid.
*a.* Fruit linear or linear-pyramidal.
*1.* Fruit mostly linear-pyramidal, 2—4 (rarely 5.5) mm long; carpels with slightly dilated base and very short, but mostly distinct basal spurs ....................... T. centrocarpa.
*2.* Fruit linear, 1—1.5 mm long; carpels with hardly any dilation at the base and no spurs ................ T. minutissima.
*β.* Fruit oblong to elliptic or ovoid.
*1.* Fruit oblong-ovoid, 2—2.5 mm long, tapering into a conical apex; very short, but distinct basal spurs.. T. trichophora.
*2.* Fruit elliptic, about 2 mm long, without any distinct apical part; no basal spurs ......................... F. Muelleri.

## II. **Crassula** L., emend. Schönl.

(Sect. *Tillæoidea* Schönl.).

I think the authors who include *Tillæa* in the genus *Crassula* are right, and I follow in this respect Schönland in his treatment of the genus in Engler u. Prantl, Natürl. Pflanzenfam. (Crassulaceæ, 1891) and in his recent monograph of the South-African species of the section *Tillæoidea* (Ann. Bolus Herb. II, 2, 1916).

I have found it necessary to restore two of Nees ab Esenbeck's species and to create a new one. Some of the species I have had in culture from seeds taken from herbarium specimens kindly sent by Mrs. M. Davis of Perth, and they have kept their characters very well under cultivation.

In the following key I have given the distinction marks for all the species hitherto recorded for W. A.

### A Key to the W. Australian Species of Crassula.

*A.* Flowers axillary in dense few- to several-flowered clusters (rarely solitary in the axils and then sessile), forming spike-like inflorescences, 5- (rarely 4-) merous; seeds two in each carpel.
*a.* Carpels broad, short, obtuse with medium-long style, much shorter than the calyx; at least some flowers on pedicels longer than the calyx ............................................. C. Miriamæ.
*b.* Carpels long, oblique ovate, acute with a long style; flowers sessile or very shortly stalked.

*1.* Stem and branches ascending from a decumbent (sometimes rooting?) base; carpels with recurved beak....... C. intricata.
*2.* Stem straight, erect; carpels with nearly straight beak. C. colorata.

*B.* Flowers axillary, solitary or few together, 4-merous; seeds 1 — several in each carpel.
*a.* Flowers few together at the uppermost part of the plant; 1 seed in each carpel. Water-plant .......................... C. natans.
*b.* Flowers solitary in the axils.
*1.* Leaves 0.5—1.0 cm long; 2 (3) seeds in each carpel. Pedicels shorter than the leaves ......................... C. recurva.
*2.* Leaves not reaching 0.5 cm; several seeds in each carpel. Pedicels much longer than the leaves ............. C. bonariensis.

*C.* Flowers in rich dichotomous panicles, 4-merous; several seeds in each carpel...................................... C. macrantha.

*D.* Flowers subumbellate at the top of the plant. 3—4-merous; several seeds in each carpel............................... C. pedicellosa.

## 1. Group: Helophythum Schönl.

1. **Crassula natans** Thunb., Prodr. Fl. Cap. (1794) 54; Schönland in Ann. Bolus Herb. II. 2, 1916 (1917) 47 (ubi synon.); Diels et Pritzel, in Botan. Jahrb. 35 (1904) 210.

Armadale, on damp soil (dried-up ditches) along the railway, in flower and with ripe fruits (No. 361, 20. Sept. 1914).

This inconspicuous species was first found in W. A. by DIELS and PRITZEL at Newcastle, distr. Avon; the specimens were floating in a pond. Our specimens grew in dried-up ditches and were small and slender; they agree well with the f. *filiformis* (*Helophytum filiforme* Ecklon et Zeyher no. 1844, 289) as defined by SCHÖNLAND (l. c. 49).

Geogr. area: South Africa.

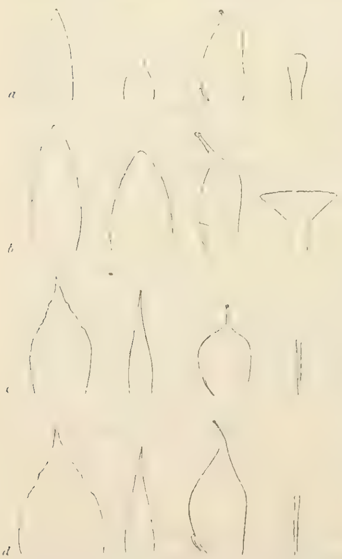


Fig. 10. Sepals, petals, and carpels with nectary scales (10 times enlarged), and nectary scales isolated (20 times enlarged) of *Crassula* species. *a*, *C. pedicellosa* (F. v. Müll.); *b*, *C. macrantha* (Hook. f.) Diels et Pritzel; *c*, *C. Miriamæ* Ostf.; *d*, *C. colorata* (Nees).

## 2. Group: Vaillantii Schönl.

2. **Crassula macrantha** (Hook. f.) Diels et Pritzel, in Botan. Jahrb. 35 (1904) 210; *Tillæa macrantha* Hook. f. in Hook. Icon. plant. t. 310 (1841);

Bentham, Fl. Austral. II (1864) 457; J. M. Black, in Transact. R. Soc. S. Austr. XL (1916) 63.

Seems to be fairly distributed in damp places in the neighbourhood of Perth. Specimens were collected at Mundaring Weir (No. 363, 13. Sept. 1914), in several places around Armadale (Nos. 358, 359, 362, 20. Sept. 1914) and in the vicinity of Perth (No. 1349, Mrs. M. Davis, 1915). They were in flower and with ripe fruits in September. Often they are more or less red-coloured, especially the sepals and carpels.

The species was first recorded for W. A. by Diels and Pritzel. It was originally described from Tasmania, and is, according to F. v. Müller (Sec. Census, 84), further found in N. S. Wales, Victoria and S. Australia.

From Hooker's description it appears that the original Tasmanian plant has ciliated sepals. All the West Australian have no trace of ciliation, and may be worth giving a varietal name (var. nov. *nuda:* sepala nuda, non ciliata). Bentham (l. c.) mentions the sepals as "sometimes, but not always, ciliate".

Fig. 11. *Crassula macrantha* (Hook. f.) Diels et Pritzel, var. *nuda* nov. var. Cultivated specimen. (Nat. size)

I have had it in cultivation (in 1917) from seeds taken from plants collected by Mrs. Davis in 1915 (No. 1349). When flowering it has a strong honey-smell.

The cultivated specimens, one or which is drawn (fig. 11), grow to a size of ca. 10 cm, and are somewhat more elongated than the spontaneous ones. The leaves are oblong-linear, semi-terete, acute or acuminate. The flowers are usually 4-merous, larger than in other species; they open when full-grown, the green sepals and white petals spreading (diameter about 3 mm); often the petals, which are about as long as the sepals, have pink-

coloured tips. The stamens have orange pollen. The nectary scales are broadly obcuneate or wedge-shaped (see fig. 10 *b*) and reddish; they secrete large drops of honey. The carpels are green, oblique-ovate with a well developed style and a small stigma; when ripe each contains several (about 6) brown, shortly oblong-cylindrical seeds with a finely rugose testa.

The Australian species comes near to the South-African *C. decumbens* Thunb. (*Bulliarda trichotoma* Eckl. & Zeyh., see Schönland, l. c., 53).

Geogr. Area: Extra-tropical Australia and Tasmania.

3. Group: Umbellata Schönl.

3. **Crassula pedicellosa** (F. v. Müll.) comb. nov.; *Tillæa macrantha*, var. *pedicellosa* F. v. Müller, Fragm. Phytogr. Austr. XI (1881) 118; J. M. Black in Transact. R. Soc. S. Austr. XL (1916) 63; *T. pedicellosa* F. v. Müller, Syst. Census of Austral. Plants I (1882) 48.

Fig. 12. *Crassula pedicellosa* (F. v. Müll.) Ostf.; cultivated specimen. (Nat. size).

In his Fragmenta XI, F. v. Müller mentions (118), under *Tillæa macrantha*, a new form of which he gives the following description: Varietatem pedicellosam, pedicellis plerisque elongatis calyce pluries multotiesve longioribus detexi in pascuis fertilioribus collinis ad basim montium Stirlingi; hæc varietas quasdam Mitrasacmes species simulat præsertim etiam ramificatione parciore v. parcissima et inflorescentia passim quasi umbellata, nisi hæc planta forsan speciem seorsam (pedicellosam) exibet.

Shortly after (1882) he enumerates it as a distinct species, but has, as far as I am aware, not given any more elaborate description of it. As the description quoted is very incomplete, and as I have no authentic specimens of the species at my disposal, it is with some doubt that I identify with it a small *Crassula* found near Armadale; but nevertheless I think the identification a correct one, and my plants agree with specimens kindly sent me by Mr. J. M. Black from S. Australia under the name of *Tillæa macrantha* var. *pedicellosa*.

The plant in question is a small erect annual (1—5 cm high),

in the poorest specimens unbranched, but usually branched. Leaves opposite with connate bases, obovate-oblong, obtuse, succulent, and, like the whole plant, more or less tinged with reddish-violet. Flowers in subumbellate cymes at the top of the branches, some with long stalks (up to 1 cm), others short-stalked or nearly sessile. Flowers 4-merous (sometimes 3-merous), sepals (about 1.5 mm long) broadly lanceolate-oblong, acute to acuminate, succulent, never spreading, longer than the subacute ovate petals (1.0—1.3 mm long). Stamina 4 (3); carpels obliquely oblong-ovate with a very short style (stigma nearly sessile), when ripe exceeding the calyx, each containing many minute (0.3 mm long) brownish seeds. Nectary scales minute, obcuneate with rounded apex (see Fig. 10 *a*).

Undoubtedly this species is quite distinct from *C. macrantha*, but on the other hand it is nearly related to some South-African species (sect. *Umbellata* Schönl.), namely *C. Dodii* Schönl. & Baker f., and *C. umbellata* Thunb.

My specimens were found growing in damp clayey places near Armadale (Nos. 1104, 1105, 20. Sept. 1914) and I hade had it sent from the vicinity of Perth (Mrs. Davis, No. 1451, 1915). Of the latter specimens I have sown seeds and have had plants growing, from which the description above has been completed. They (see fig. 12) differed from the spontaneous specimens in richer branching, more slender growth, flowers on longer stalks, and very little reddish tinge.

Geogr. Area: S. and W. Australia.

### 4. Group. Muscosa Schönl.

4. **Crassula Miriamæ** nov. sp. (Figs. 10 *c* and 13). Herba annua, parva, 4—8 cm alta, ramosa. Folia succulenta, ovato-oblonga, acuta vel subacuta. Flores in glomerulis axillaribus, sessiles vel breviter pedunculati, 5-meri (rarius 4-meri intermixti). Sepala succulenta, ovato-triangulata, acuta vel acuminata, margine corrodata; petala sepalis subæquilonga, lineari-lanceolata, acuminata, albo-pellucida. Stamina brevia; carpellæ obovato-rotundatæ, obtusæ, stylo mediocri instructæ, maturæ quam sepalis incurvatis multo breviores, inflatæ. Semina 2 in carpella singula. Nectaria minuta, lineari-clavata.

Hab. Australia occid., in vicinitate urbis Perth (No. 1452, leg. Mrs. M. Davis, 1915).

Ex affinitate *C. Sieberianæ* a qua præcipue differt sepalis

brevioribus et latioribus carpellisque obovato-rotundatis, brevibus et inflatis.

Amongst the specimens of *C. pedicellosa* and *C. colorata* collected near Perth by Mrs. M. Davis was a single specimen of another species which I at first took for *C. Sieberiana*,[1] a species recorded for W. A. by Bentham (l. c.) and later authors. But on comparison of the specimen with Sieber's original plant (Pl. Sieberianæ no. 173) and with other specimens of the same species from Victoria (leg. F. v. Müller) and S. Australia (leg. J. M. Black), it soon became evident that it was an undescribed species, although allied to *C. Sieberiana*. This makes it probable that the records of *C. Sieberiana* from W. A. need confirmation. (It reaches as far west as S. Australia, according to J. M. Black, l. c.). The specimen sent had ripe seeds and from these I have grown some plants which have made it possible to give a full description of the species. I have named it in honour of the collector, my friend Mrs. Miriam Davis to whose indefatigable interest I owe a good deal of my collection of W. A. plants.

Fig 13. *Crassula Miriamæ* nov. sp., cultivated specimen. (Nat. size).

The plant (see fig. 13) is a much branching succulent, ascending or erect annual. The flowers are placed in dense clusters in the axils of the leaves; sometimes, especially on the branches, the clusters form a spike-like inflorescence. Some of the flowers are sessile and some short-stalked; the longer pedicels longer than the flower itself. Sepals from an ovate-triangular base tapering into an acute or acuminate apex and with somewhat corrodate margin. Petals much narrower and inconspicuous, linear-lanceolate, acuminate. Carpels, when ripe, shorter than the adpressed sepals, obtuse with a medium-sized slender style, somewhat inflated,

[1] *C. Sieberiana* (Schultes) comb. nov.; *Tillæa Sieberiana* Schultes, Mantissa in Roemer & Schultes, vol. III (1827) 345; *T. pedunculata* Sieber, Pl. exsicc. no. 173; non *T. peduncularis* Smith, in Rees, Encycl. V. 35, no. 4; *T. verticillaris* D. C., Prodrom. III (1828) 382; Bentham, Fl. Austr. II (1864) 451, ex parte.

broadly obovate or obovate-rotundate; each containing two ellipsoidal brown seeds. Nectary scales minute, linear-clavate (see fig. 10 *c*).

The allied *C. Sieberiana* has few-flowered flower-clusters, not aggregating into dense spike-like inflorescences, longer pedicels (several times longer than the flower), narrower sepals and much smaller and narrower carpels (see the fig. on Pl. VII of J. M. Black's paper in Trans. R. Soc. S. Austr. XL, 1916).

5. **Crassula colorata** (Nees) comb. nov.; *Tillæa colorata* Nees ab Esenbeck, in Lehmann, Pl. Preiss. I 2 (1844) 277; *T. adscendens* Nees, ibid. (non *Crassula adscendens* Thunb., 1778); *T. verticillaris* Bentham, Fl. Austr. II (1864) 451, ex parte; *T. acuminata* F. M. Reader, Vict. Naturalist XV (1900) 96; J. M. Black, Trans. R. Soc. S. Austr. XL (1916) 63, pl. VII.

Bentham (l. c.) included Nees's *T. adscendens* and *T. colorata* in his *T. verticillaris* (= *C. Sieberiana*), but was evidently wrong in this respect. I have examined Preiss's plants no. 1931 and 1932, upon which the two species were based, (specimens in the herbarium of Lund, Sweden), and have found them much different from Sieber's plant. On the other hand, the two species do not differ in any essential point from each other, and I consider them as one species only; for this I use the name *C. colorata* as *C. adscendens* is preoccupied by *C. adscendens* Thunberg (1778).

Some specimens sent by Mrs. Davis from the vicinity of Perth (No. 1350, 1915) agree well with Preiss's plants, and from them I have had cultivated specimens grown here in Copenhagen for examination. From these different sources I have been able to form a rather full idea of the species in question.

Nees's descriptions of the two plants are very exact and elaborate, and I have not much to add. He doubted himself the independence of the latter of his species ("simillima T. adscendenti, cujus nescio an sit varietas"), and the distinctive marks given are rather valueless, mostly merely modications dependent on external circumstances.

Recently F. M. Reader has created a new species, viz. *Tillæa acuminata* (Victorian Naturalist XV, 96) to the description of which I have no access. But J. M. Black has (Trans. R. Soc. S. Austr. 1916, 63) given some remarks on it, and he has sent me a herbarium specimen of it. It shows that it is the same plant as Nees's *C. colorata*, and consequently Reader's name must be reduced to a synonym. According to Black, it is widely

distributed in S. Australia, and as Reader's plant came from Victoria, the species seems to be distributed in the southern extra-tropical Australia from east to west.

Fig. 14. *Crassula colorata* (Nees) Ostf., cultivated young specimen. (Nat. size).

Combining what the descriptions give with my examination of the specimens collected by Preiss, J. M. Black and Mrs. Davis, and the cultivated plants, I give the following description of the plant (see fig. 14): An erect 5—8 cm high, branched succulent annual, branches and stem ending in ± long (often very long) and somewhat interrupted inflorescences. Leaves very succulent, ovate-oblong, obtuse, often mucronate, 2—3 mm long. Flowers in axillary dense clusters, sessile, or the older ones very shortly stalked, 5-merous. Sepals very succulent, broadly triangular-ovate, very acute with somewhat corrodate margin; petals linear-lanceolate, acuminate, white-pellucid, about as long as the sepals. Carpels, when ripe, much exceeding the sepals, oblique-ovate, acute-aristate with a nearly straight beak; seeds 2 in each carpel, brown. Nectary scales minute, linear-clavate (se fig. 10 *d*).

The species is related to the following, and to some South-African species of the *Muscosa* group (Schönland, l. c.), e. g. *C. campestris* Endl. In W. A. it is known from Preiss's two localities ("In arenosis haud longe ab opp. Freemantle" and "In arenosis silvæ prope opp. Perth") and from Mrs. Davis's collection, all three localities lying near Perth.

Geogr. area: Victoria, S. and W. Australia.

6. **Crassula intricata** (Nees) comb. nov.; *Tillæa intricata* Nees ab Esenbeck, in Lehmann, Pl. Preiss. I 2 (1844) 278.

In the herbarium of Lund (Sweden) I have examined a specimen of Preiss's no. 1929: "*Tillæa* (*Bulliarda*) *intricata* N. ab E. In arenoso-conchyliosis humidis prope lacum insulæ Rottennest, Aug. 19. 39". The specimen is a rather poor one, but careful observation makes it possible to compare the plant with Nees's description (l. c.). On the whole they agree with each other, but in one

important point the description is erroneous, viz. the number of ovules is not several ("ovula plura"), but only two, as in the preceding species. No doubt Preiss's plant is very near his two other species, and the only reason for placing *T. intricata* under the subgen. *Bulliarda* (while the two others are placed under *Tillæa* proper) was the supposed differences in the number of ovules, and this is wrong.

Near the Yallingup Cave House I collected a *Crassula* on sandy open places (No. 360, 26. Aug. 1914) which is identical with Preiss's plant, and my richer material allows me a fuller conception of the species, which is, in reality, very close to *C. colorata*. The main differences are the quite different habit, owing to the decumbent and rich branching, the solitary or few flowers in the axils, and the recurved beak of the fruiting carpels. A short description runs as follows:

A much branched annual with decumbent bases of the stem and branches, and ascending upper parts, 2—5 cm high. Leaves succulent, ovate-oblong, obtuse, 2—3 mm long. Flowers axillary, solitary or in few-flowered clusters, sessile or nearly so, 5-merous, forming long interrupted spike-like inflorescences. Sepals broadly ovate, acute-acuminate; petals linear-lanceolate, acuminate, as long as or a little longer than the sepals. Stamens somewhat shorter. Carpels, when ripe, much exceeding the sepals, oblong-ovate, acute, tapering evenly into a recurved beak; seeds two in each carpel, brown. Nectary scales minute, linear-clavate.

The species seems to belong to the coastal area and may be a coastal vicarious species for *C. colorata*. Hitherto known only from Rottnest Island off Freemantle and Yallingup Cave House.

There are two more species of *Crassula* recorded for W. Australia, viz. *C. bonariensis* Cambes (= *Tillæa purpurata* Hook. f.) and *C. recurva* (Hook. f.); but whether these records are correct or not, I do not know, as I have not seen Drummond's plants, among which they are found (according to Bentham, l. c. 452). I have included them in the key to the W. Australian species of *Crassula* given above (see p. 39). In the Eastern states there are further *C. Sieberiana* (Schultes), mentioned above, and the newly described Victorian species *C.* (*Tillæa*) *exserta* (F. M. Reader in Vict. Naturalist XIV, p. 83) which I have not seen.

## III. Frankenia.

The Frankenias of West Australia are rather difficult to extricate. The treatments by the different authors (Turczaninow,

Bentham and Diels) show great uncertainty with regard to the delimitation of the species. Niedenzu, in his survey of the *Frankeniacæ* in Engler u. Prantl., Natürl. Pflanzenf. (III, 6, 1895, pp. 283—289) divides the subgenus *Oceania*, to which all the Australian species belong, into two sections, according to the number and place of the ovules. After examination of a number of specimens of West Australian Frankenias in the herbaria of Copenhagen and Berlin, I have found this distinction mark a good one.[1] I distinguish between: (1) ovules on 2—3 parietal placentas, more than two on each placenta; (2) ovules 1—2 on each parietal placenta; and (3) ovules only 2—3, basal on long funicles. These three groups fit in for the West Australian species, but I have examined a plant from Port Pirie, S. Austr., which seemed to have 9 basal ovules. My two first groups are Niedenzu's *Toichogonia*, and my last group his *Basigonia*.

Using these characters as the principal ones, and then those given by Bentham in his very good treatment of the genus in Fl. Austral. vol. I, I have arrived at the conclusions given in the following.

I have found it necessary to describe some new species, and I feel convinced that further researches will result in still more new discoveries. As Diels, in his Fragm. Phytogr. Austr. occ., remarks, *F. pauciflora* belongs to "einen polymorphen Formen-Kreis", and my examination of specimens labelled *F. pauciflora* have shown that some belonged to sect. *Toichogonia* and others to *Basigonia*; these must of course be separated from each other.

It is not possible yet to arrange the species of *Frankenia* into natural groups, as our knowledge is too restricted, and the following key to the West Australian species must, therefore, be taken only as an arrangement according to the characters most easily used for distinction.

### A Key to the West-Australian Frankenias.

*A.* Placentas parietal, each bearing several (more than 2) ovules. Stems decumbent to erect; flowers large or smaller.

- *a.* Leaves shortly, but distinctly petiolate; flowers in leafy dichotomous cymes.
  - *1.* Leaves linear, with margins revolute until the midrib; flowers large; stem decumbent or ascending, glabrous or pubescent; calyx glabrous or pubescent .......................... F. pauciflora.
  - *2.* Leaves, at least the lower ones, ovate with only the margins re-

[1] Niedenzu, by the way, not having sufficient material at his disposition, has arranged the Australian species wrongly under his headings.

curved; flowers smaller; stem erect or ascending, densely pubescent; calyx pubescent ........................ F. serpyllifolia.

*b.* Leaves sessile, linear, short; flowers in dense heads (aggregated cymes) at the top of the branches, rather small; stem, leaves and calyx puberulous ........................................ F. conferta.

*B.* Placentas parietal, each bearing 1—2 ovules; stems decumbent; flowers small, solitary or in dichotomous cymes.

*a.* Stems quite glabrous; leaves linear-terete, distinctly petiolate; flowers solitary ........................................ F. Drummondii.

*b.* Stems more or less puberulous; leaves subsessile or sessile; flowers in leafy dichotomous cymes.

*1.* Calyx more or less imbedded in a sheath formed by 4 floral leaves, glabrous; stems sparingly puberulous, lower leaves oblong-ovate, floral leaves triangular-ovate ................ F. ambita.

*2.* Calyx sessile (not imbedded), with 4 linear floral leaves, hairy; stems densely hairy with a short pubescence; leaves linear-terete. F. Maidenii.

*C.* Ovules 2—3, basal, on long funicles.

*a.* Flowers in dense heads (contracted cymes) at the top of the branches; leaves distinctly petiolate with ciliate sheaths; stems erect, internodes much longer than the linear-terete, glabrous, revolute leaves.

*1.* Floral leaves ovate-lanceolate, flat and strongly ciliate, much broader than the stem-leaves ................... F. bracteata.

*2.* Floral leaves like the stem-leaves, linear-terete.

† Glabrous or nearly so ...................... F. glomerata.

†† Branches, young leaves and calyx hairy with short bristly hairs ........................................ F. setosa.

*b.* Flowers solitary or in leafy dichotomous cymes at the top of the branches; stems decumbent (or rarely erect?).

*1.* Leaves sessile, shortly linear-terete (under 5 mm long); stems decumbent; flowers small.

† Leaves not produced below their insertion, acute or obtuse; stamens 4, style 2-cleft, ovules 2 .......... F. tetrapetala.

†† Leaves produced below their insertion into a free, closely adpressed appendage; stamens 6, style 3-cleft, ovules 3 (2—4?). F. punctata.

*2.* Leaves distinctly, but often minutely petiolate on the margin of the sheath.

† Leaves very short (not exceeding 2 mm), terete-oblong, much revolute, obtuse, glabrous; sheath rather long (half as long as the blade), with strong cilia ................. F. parvula.

†† Leaves longer (3—6 mm); sheath much shorter than the blade.

o Leaves more or less hairy on the upper surface; branches and calyx densely hairy ................. F. Interioris.

oo Leaves glabrous on the upper surface; branches sparingly pubescent; calyx glabrous.

+ Leaves oblong, flat with revolute margins and densely hairy lower surface; internodes much shorter than the leaves; styles 3, ovules 3 .............. F. compacta.

++ Leaves linear, revolute; internodes longer than the leaves; styles 2, ovules 2 ........................ F. Georgei.

1. **Frankenia pauciflora** D. C. Prodr. I (1824) 350; Curtis, Botan. Magaz. tab. 2896; Benth., Fl. Austr. I (1863) 151; maxima ex parte.

The specimens from the coastal region are decumbent shrubs with internodes several times longer than the leaves. Stems

Fig. 15. *Frankenia serpyllifolia* Lindl., from W. A. (Herb. Berol., ded. F. v. Müller). ($1^1/_2$ nat. size).

glabrous or, especially the younger, somewhat pubescent. Leaves oblong or linear, obtuse, revolute, glabrous, distinctly petiolate, 8—10 mm long; sheaths ciliate. Flowers in leafy dichotomous cymes. Corolla pink. Several ovules on each of the three parietal placentas (I have counted 21—24 ovules in the ovary).

Specimens examined: Carnarvon, common in dune depressions: Diels 1901 (No. 3722, herb. Berol.); Dr. I. B. Cleland (ex herb. Mus. Perth); C. H. Ostenfeld (No. 1101, 31. Oct. 1914). In arenosis exsicc. inter Restiones ad ripam fluvii Cygnorum prope Peninsulam, Herb. Preiss No. 1283.

A coarser, nearly erect form has the same floral characters, but has larger (broader and thicker) calyx and shorter, thicker leaves (only 3—5 mm long); this is, probably, the original form described by De Candolle. It is present in Herb. Berol: (1) Nova Hollandia, Côte occid. Ex Museo Paris 1819, Hb. Kuntze. (2) Inneres West-Australien, Murrin-Murrin, W. J. George 1902, comm. L. Diels.

2. **Frankenia serpyllifolia** Lindley, in Mitchel, Trop. Austr. (1848) 305; *F. pauciflora*, var. *serpyllifolia* Benth., Fl. Austr. I (1863) 152.

An erect much branched shrub (20 cm high) with elongated densely pubescent internodes and divaricate dichotomous cymes (Fig. 15). Leaves short and broad, especially the lower, broadly ovate to linear-ovate (the floral ones), with revolute margins (but not so much as in other species), glabrous on both surfaces. Flowers smaller than in *F. pauciflora*; calyx hairy. Floral characters otherwise as in *F. pauciflora* (several ovules etc.).

In Herb. Berol. a specimen presented by the late F. v. Müller and labelled »West Austr.« has been named *F. serpyllifolia* by Bray[1]), and I think with good reason. It is near *F. pauciflora*, but the differences in the vegetative parts are so great that I think it a good species.

3. **Frankenia conferta** Diels, in Diels et Pritzel, Fragm. Phytogr. Austr. occ., Botan. Jahrb. 35 (1904) 389.

I have seen part of the type specimen (in Herb. Berol.) and refer to Diels' exhaustive description. No doubt it is near to *F. pauciflora*, the floral characters of which are the same.

4. **F. Drummondii** Benth. in Fl. Austr. I (1863) 152.

I have not seen any specimens of this species, and have placed it in the key according to the description.

5. **F. ambita** Ostf., see above p. 24 (Fig. 9).

Seems to be restricted to the north-western part of the state.

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[1]) cfr. Bray, W. J.: The geographical Distribution of the Frankeniaceæ considered in connection with their systematic Relationships. Engler, Bot. Jahrb. XXIV (1897).

6. **Frankenia Maidenii** nov. sp. (Fig. 16).

Fruticulus decumbens ramosissimus, caulibus calycibusque dense breviterque setuloso-puberulis, internodiis foliis subduplo longioribus. Folia brevia (3—4 mm longa), crassiuscula, sessilia, omnino revoluta, brevissime setuloso-puberula (saltem juniora, seniora concretione calcarea (?) alba tecta), basi ciliata, subteretia, linearia, false 4-verticillata vel inferiora opposita vagina brevissima ciliata vel nulla. Flores in cymis aliquoties dichotomis, sessiles. Calyx linearis, 4—5 mm longus. Corolla parva, rosea; petala, ut stamina, infra medium cohærentia, lamina obovata; stamina 6, inæqualia; styli rami 3; ovula 2 in placentis (3) singulis fixa.

Fig. 16. *Frankenia Maidenii* nov. sp., from Cue, W. A. ($1^1/_2$ nat. size).

Hab. Austr. occ. interioris ad Cue (leg. J. H. Maiden, Oct. 1909, ex herb. Nationali New South Wales, sub. nom. *F. punctatæ*; typus in Herb. Copenhagen).

In habit this species resembles *F. ambita*, from which it differs in the dense clothing of very short hairs and in the sessile leaves and sessile (not imbedded) calyx. From *F. pauciflora* D. C. it differs in the short sessile leaves, the few ovules, the short and dense clothing etc. From *F. punctata* it is easily distinguished by wanting the basal appendages of the leaves and by the lateral placentas. The later character as well as the 5-merous flowers distinguish it from *F. tetrapetala*.

7. **Frankenia bracteata** Turcz., Bull. Mosc. XXVII (1854) 367; Benth. Fl. Austr. I (1863) 150; Diels et Pritzel, Fragm. Phytogr. Austr. occ., Botan. Jahrb. 35 (1904) 389.

I have seen the specimens quoted by DIELS and PRITZEL (l. c.) and collected by PRITZEL (No. 816) at Waeel (dist. Avon).

8. **Frankenia glomerata** Turcz., Bull. Mosc. XXVII (1854) 368; Benth. Fl. Austr. I (1863) 151.

To this species I refer some specimens in Herb. Berol. named *F. pauciflora*, namely: No. 5707, Northampton, L. Diels. They agree in all points with the description given by Bentham (l. c.).

9. **Frankenia setosa** W. V. Fitzgerald, in Journ. W. Austr. Nat. Hist. Soc. no. 1 (1904) 3.

Known to me only from the description; perhaps only a hairy variety of *F. glomerata*.

10. **Frankenia tetrapetala** Labill., Nov. Holl. Plant. spec. I (1804) 88, tab. 114; Benth., Fl. Austr. I (1860) 152; Diels et Pritzel, Fragm. Phytogr. Austr. occ., Botan. Jahrb. 35 (1904) 390.

I have only seen the specimens collected by Diels (quoted by Diels and Pritzel, l. c.) near Esperance (no. 5450).

11. **Frankenia punctata** Turcz., Bull. Mosc. XXVII (1854) 367; Benth., Fl. Austr. I (1860) 153; Diels et Pritzel, Fragm. Phytogr. Austr. occ., Botan. Jahrb. 35 (1904) 390.

Only the specimens quoted by Diels and Pritzel (l. c.) from Cummening (distr. Avon) were seen.

12. **Frankenia parvula** Turcz., Bull. Mosc. XXVII (1854) 368; Benth. Fl. Austr I (1860) 152.

Of this species I have only seen a fragment of Drummond's 5th Coll. Suppl., no. 81.

13. **Frankenia Interioris** nov. sp. (Fig. 17).

Fruticulus ramosissimus decumbens; rami dense setoso-pubescentes, foliis longiores vel breviores. Folia brevia (3—4 mm longa), lineari-teretia, obtusa vel acuta, valde revoluta, plus minus dense pilis brevissimis curvatis vel rectis patulis prædita, brevissime petiolata, vagina haud manifesta ciliataque. Flores in cymis dichotomis paucifloris, parvi; calyx linearis (5—6 mm longus), dense setoso-pubescens, 5-dentatus; petala 5 rosea, unguibus cohærentibus, laminis obovatis, margine dentata; stamina 6 inæqualia; styli rami 3; ovula 3, basalia.

Fig. 17. *Frankenia Interioris* nov. sp., from Kalgoorlie (no. 1110). ($1^1/_2$ nat. size).

Hab. Austr. occid. interioris: in deserto ad Kalgoorlie (No. 1110, 7. Octob. 1914, typus); ad Bullabulling (L. Diels, no. 5202, in Herb. Berol., sub nom *F. paucifloræ*).

This decumbent small-leaved shrub seems to be common in the arid interior of the southern part of the State, perhaps taking the place of *F. pauciflora* of the coast region. It is easily distinct from the latter by the three basal ovules and the dense hairiness as well as by the smaller leaves, shorter internodes etc.

Fig. 18. *Frankenia Interioris* var. *conspicua* nov. var., from Coolgardie. ($1^1/_2$ nat. size).

From *F. Georgei* Diels it differs in the dense hairiness, the cohærent petals and the three ovules and three style-branches.

var. **conspicua** nov. var. (Fig. 18). Differt a typo dimensionibus majoribus; internodiis foliis longioribus; foliis latioribus oblongo-ovatis vel oblongis, margine solum revoluta, subtus glabris, 5—7 mm longis, obtusis, distincte petiolatis; calycibus majoribus, 6—7 mm longis; corollis conspicuoribus; ceterum ut in typo.

Hab. Austr. occ.: Coolgardie Goldfields, J. Wood, Oct. 1908 (Herb. Copenh., ex Herb. New South Wales, sub nom. *F. paucifloræ*).

A plant kindly sent me by Mr. J. H. Maiden of Sydney, I consider as a luxuriant variety of *F. Interioris*. It has a rather different habit, but agrees in all essential characters with the main species.

14. **Frankenia Georgei** Diels, in Diels et Pritzel, Botan. Jahrb. 35 (1904) 389.

I have not seen this species, which was based upon specimens collected at Murrin-Murrin (Distr. Austin) by W. J. George, 1902.

15. **Frankenia compacta** nov. sp. (Fig. 19).

Fruticulus decumbens et repens, ramis brevibus, dense foliatis superne sparse setoso-hirsutis, internodis foliis multo brevioribus. Folia oblonga, obtusa, plana, margine solum revoluta, supra glabra, subtus dense hirsuta, distincte petiolata, vagina ciliata, 4—5 mm longa. Flores in densis cymis dichotomis, sessiles, mediocri; calyx linearis, ca. 5 mm longus, glaber; corolla (an pallide-lutea?); petala

Fig. 19. *Frankenia compacta* nov. sp., from Wagin Lake. ($1^1/_2$ nat. size).


Australian Annual Triglochins.

1. *T. centrocarpa* var. *nana*, from S. A., Port Elliot. 2. *T. centrocarpa*, typica, 3 specimens from W. A., Armadale. 3. *T. centrocarpa*, var. *brevicarpa*, from W. A., Yallingup Cave. 4. *T. centrocarpa*, var. *nana* from Vict., Station Peak (leg. F. v. Müller). 5. *T. trichophora*, from W. A., Busselton. 6. *T. trichophora* (spec. authent.), Preiss no. 2411 (from the herb. of Lund). 7. *T. calcitrapa*, var. *pedunculata*, from W. A., Yallingup Cave. 8. *T. Mülleri*, from W. A., Vasse River (part of type collection). 9. *T. turrifera* from Vict., Little Desert. 10. *T. turrifera*, from Vict., Taylors Creek. 11. *T. Stowardii*, from W. A., Beverley (part of type collection). 12–13. Preiss no. 2409 (from the Melbourne herb.) containing young *T. centrocarpa* (12) and *T. minutissima* (13), part of type collection. (Photo. of herbarium specimens; nat. size).

5; lamina obovata, margine dentata; stamina 6, subtus cohærentia, styli rami 3, ovula 3 basalia.

Hab. Austr. occid.: ad Wagin Lake (leg. Miss Crown 1891, Diels no. 7835 in Herb. Berol., ex Herb. Melbourne).

This species is very distinct from the others by the nearly flat oblong leaves with densely pubescent lower surfaces, by the short internodes, the dense foliage and inflorescence and by the floral characters.

# Chenopodiaceæ from West Australia.

By

Ove Paulsen.

The Chenopodiaceæ collected by Dr. C. H. Ostenfeld in Western Australia and handed over to me for identification are of importance, because every contribution to the botany of those little-known countries must be welcomed. But especially with regard to this family our knowledge is scarce, and most of all this applies to the group Salicornieæ, which has been very much neglected. — Several doubtful or difficult questions have arisen; in such cases I have figured the material; and if the species concerned are thus rendered recognisable for others with certainty, an advance is made, even if my decisions be not correct in every case.

## I. Rhagodia R. Br.

1. **R. Gaudichaudiana** Moq., in D. C. Prodr. XIII 2 (1849) 53; Benth. Fl. Austr. V (1870) 154.

Kalgoorlie (No. 335, 7. Oct. 1914).

2. **R. baccata** (Labill.) Moq., in D. C. Prodr. XIII 2 (1849) 50; *Chenopodium baccatum* Labill. Nov. Holl. pl. spec. I (1804) 71, tab. 96; *Rhagodia Billardieri* R. Br. Prodr. (1810) 408; Benth. Fl. Austr. V (1870) 152; F. v. Müll. Iconogr. Austr. Sals. 3 (1890) tab. 21.

Leaves opposite. Fruits fleshy, red.

Carnarvon, in dunes (No. 344, 31. Oct. 1914).

3. **R. parvifolia** Moq., in D. C. Prodr. XIII 2 (1849) 52; *R. crassifolia* R. Br. var., Benth. Fl. Austr. V (1870) 155.

An undershrub; leaves small (5—8 mm long), obovate to oblong, mealy; inflorescence very open, spiciform. Flowering.

Kalgoorlie (No. 327, 8. Oct. 1914).

## II. Chenopodium.

4. **C. nitrariaceum** F. v. Müll., in Benth. Fl. Austr. V (1870) 158; F. v. Müll. Iconogr. 3 (1890) tab. 28.

Leaves mostly opposite. Plant pubescent, by characteristic hammer-shaped hairs (Fig. 20). Suffrutescent; in No. 328 there are long dead shoot-systems, and the year-shoots are only about 5 cm long. In No. 343 they attain a length of 15—20 cm. Both bear young fruits and single ripe ones.

Tammin, in heath (No. 328, 6. Oct. 1914); Geraldton, in sand dunes (No. 343, 28. Oct. 1914).

Fig. 20. Hair of *Chenopodium nitrariaceum.*

## III. Atriplex L.

5. (?) **A. stipitatum** Benth. Fl. Austr. V (1870) 168.

The specimens collected being male only, they are not discernible from *A. Moquiniana* Web., which species according to Bentham differs from *A. stipitatum* by its fruiting bracteoles.

Male clusters in open spikes. Flowers yet unopened.

Kalgoorlie (No. 336, 10. Oct. 1914).

6. **A. rhagodioides** F. v. Müll., Benth. Fl. Austr. V (1870) 172.

Of this frutescent and mealy-white species two specimens are present in the collection. The first, No. 346, is a female specimen without any male flowers, but whith numerous fruits clustered along the branches. The bracteoles are without dorsal appendages, thickened to the top or nearly so, a narrow strip of thin tissue being sometimes left. The outline varies from rhomboid to nearly semiorbicular and broader than long; a medial point or blunt angle is always present. Width of bracteoles about 5—6 mm. — Most of leaves in this plant are hastate-lanceolate, but entire ones are also found.

The second plant, No. 347, is male, nevertheless some few fruits are found. The male flower-clusters are terminal, globular; only on the main shoots more are combined, so as to form something like a spike or panicle. — The leaves are lanceolate and entire, only the uppermost ones are angular below.

Carnarvon, in dunes (No. 346, 347, 31. Oct. 1914).

7. (?) **A. angulatum** Benth. Fl. Austr. V (1870) 174; F. v. Müll. Iconogr. 2 (1889) tab. 11.

No flowers or fruits present. The plant seems to be an erect shrub.

Kalgoorlie (No. 337, 7. Oct. 1914).

8. **A. exilifolia** F. v. Müll. Fragm. VII (1869) 9; Benth. Fl. Austr. V (1870) 175.

A semiglobose low undershrub. Flowering.

Port Hedland, in dune depressions (No. 1145, 3. Nov. 1914).

9. **A. spongiosa** F. v. Müll., in Benth. Fl. Austr. V (1870) 179; F. v. Müll. Iconogr. 2 (1889) tab. 20.

Carnarvon, in sand dunes. Fruiting (No. 345, 31. Oct. 1914).

## IV. Chenolea Thunb.

10. **C. carnosa** (Moq.) Benth. Fl. Austr. V (1870) 190; *Echinopsilon ? carnosus* Moq., in D. C. Prodr. XIII 2 (1849) 136; *Bassia carnosa* F. v. Müll. Cens. Austr. pl. (1882) 30.

The perianth being spineless and wingless, this species must be named *Chenolea* and not *Bassia*. Suffrutescent; fruits unripe.

Kalgoorlie (No. 334, 7. Oct. 1914).

## V. Bassia All.

11. **B. sclerolænoides** (F. v. Müll.) F. v. Müll. Cens. Austr. pl. (1882) 30; *Echinopsilon sclerolænoides* F. v. Müll. Fragm. VII (1869) 13; *Chenolea sclerolænoides* (F. v. Müll.) Benth. Fl. Austr. V (1870) 192.

Suffrutescent; fruiting.

Kalgoorlie (No. 333, 7. Oct. 1914).

12. **B. diacantha** (Nees) F. v. Müll. Cens. Austr. pl. (1882) 30, Iconogr. 8 (1891) tab. 78, *Anisacantha diacantha* Nees, in Lehm. pl. Preiss. I (1845) 635; *Kentropsis diacantha* Moq., in D. C. Prodr. XIII 2 (1849) 138; *Sclerolæna diacantha* Benth. Fl. Austr. V (1870) 194.

Fruiting.

Kalgoorlie (No. 338, 7. Oct. 1914).

13. **B. Drummondii** (Benth.) F. v. Müll. Cens. Austr. pl. (1882) 30; *Anisacantha Drummondii* Benth. Fl. Austr. V (1870) 199.

Stem and leaves strigose-tomentose, otherwise the plant agrees with BENTHAM'S description. Fruiting; perianth bearing two long spines and one very short; seed vertical.

Kalgoorlie (No. 339, 7. Oct. 1914).

## VI. Kochia Schrad.

14. **K. villosa** Ldl., in Mitch. Trop. Austr. (1848) 91; quoted from Benth. Fl. Austr. V, (1870) 186; F. v. Müll. Iconogr. 6 (1890) tab. 53; Diels in Engl. Jahrb. 35 (1905) 185.

A low erect shrub, young stems white-tomentose, leaves

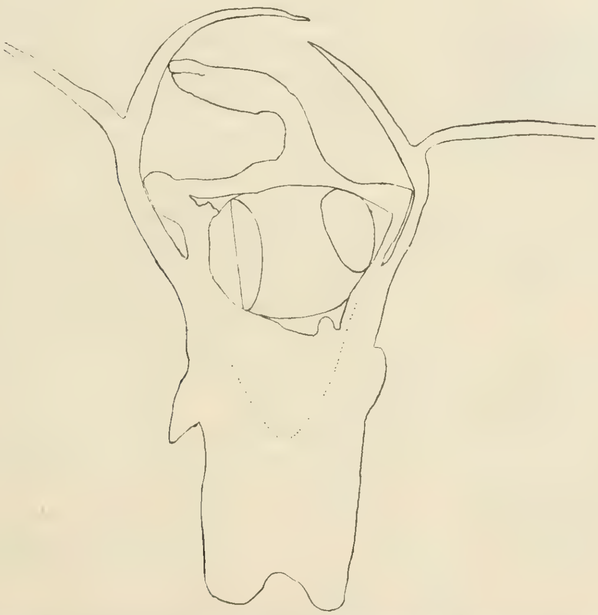

Fig. 21. Fruit of *Kochia Ostenfeldii* in longitudinal section. The section was somewhat excentric; the stipled line shows the extent of the inner cavity in center. About $^4/_1$.

terete, silky-tomentose, glabrescent; fruiting perianth 17—19 mm diam., glabrous, yellowish-brown.

Kalgoorlie (No. 342, 7. Oct. 1914).

15. **K. villosa** Ldl. var. **humilis** Benth. Fl. Austr. V (1870) 187.

Agrees with F. v. MÜLLER'S specimens from Murray desert (Herb. Berlin). A low suffrutex, very hairy. Flowering and fruiting; fruiting perianth lanate, with reddish tint, diameter 7—9 mm.

Kalgoorlie (No. 325, 7.—8. Oct. 1914).

16. **K. sedifolia** F. v. Müll., Journ. of Bot. 8 (1856) 205; Iconogr. 6 (1890) tab. 54; Benth. Fl. Austr. V (1870) 187.

Leaves clavate tomentose, in dried state perfectly brown. Fruits few, fruiting perianth 6 mm diam.

Kalgoorlie (No. 329, 7. Oct. 1914).

17. **K. Ostenfeldii** n. sp. (Pl. V fig. 1).

K. ut videtur annua, caule stricte erecto ramis numerosis brevibus erecto-flexuosis munito et obtecto, dense lanato-tomentoso, tomento in ramis junioribus albo breviusculo (axillis tamen longe lanatis), in partis vetustioribus brunnescenti; folia permulta teretia obtusa glabrescentia, dum novella lana axillari obtecta. Flores solitarii, perianthium floriferum ad medium lobatum lobis inæqualibus extrinsecus dense tomentosis, perianthium fructiferum basi turbinato-cylindrico verticaliter anguste quinque-alatum, alis superne inferneque liberis, superne membrana horizontali disciformi circulari semel interrupta glabra instructum, apice semierectum, lobis pyramidem brevem pubescentem formantibus colore nigrescenti. (Fig. 21, 22).

Fig. 22. Ripe fruit of *Kochia Ostenfeldii* seen from below. About $^{2}/_{1}$.

Alt. plantæ 20—50 cm, long. ramorum 3—10 cm, long. foliorum adultorum 1—1.5 cm, alt. perianthii fructiferi 0.5 cm, diam. membranæ horizontalis 1.1—1.2 cm.

Kalgoorlie (No. 324, 7. Oct. 1914; No. 326, 8. Oct. 1914).

## VII. Enchylæna R. Br.

18. **E. tomentosa** R. Br. Prodr. (1810) 408; Benth. Fl. Austr. V (1870) 181; F. v. Müll. Iconogr. 9 (1891) tab. 85.

Fruiting.

Kalgoorlie (No. 331, 7. Oct. 1914).

## VIII. Threlkeldia R. Br.

19. **T. diffusa** R. Br. Prodr. (1810) 410; Benth. Fl. Austr. V (1870) 197; F. v. Müll. Iconogr. 9 (1891) tab. 86.

A small shrub; fruiting.

Geraldton, in sand-dunes (No. 348, 28. Oct. 1914).

## IX. Arthrocnemum Moq.

Since 1870, the year when Vol. V of BENTHAM's Flora appeared, no original treatment of Australian Salicornieæ has been published. Only some of BENTHAM's species have been given generic rank by HOOKER (*Tecticornia, Pachycornia*) who adds "analysis florum ob mollitiem organorum difficillima". It is true that it is a difficult tribe, and it seems to be disliked by systematists.

In trying to identify the species collected by Dr. OSTENFELD I have been able to compare them with Australian specimens from the Berlin Museum, kindly placed at my disposal by Professor DIELS. For the rest, no material was at hand for comparison, so I had to name the plants mostly after descriptions.

Allthough some of the species are not known to belong to the genus named above, they are enumerated here; when their seeds become known they may, if needed, be removed to other genera.

20. **A. Arbuscula** (R. Br.) Moq., Chen. mon. enum. (1840) 113; D. C. Prodr. XIII 2 (1849) 152; *Salicornia arbuscula* R. Br. Prodr. (1810) 411; Benth. Fl. Austr. V (1870) 203. (Pl. VI, fig. 1).

A shrub forming dome-like cushions. Spikes short; the fruiting perianths are horizontally emerging, free, and dentate above (Fig. 23). Pericarp thin and membranaceous, radicle below, albumen lateral and embryo curved.

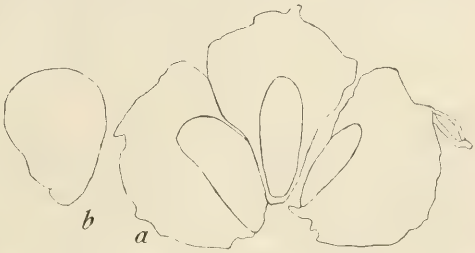

Fig. 23. *Arthrocnemum Arbuscula. a*, ripe perianths with seeds. *b*, seed seen from the side. About $^{10}/_{1}$.

Fruiting, only No. 330 not, this was apparently dying.

Kalgoorlie (No. 330, 7. Oct. 1914); Carnarvon (No. 351, 31. Oct. 1914); Port Hedland, in dune pans (No. 1142, 3. Nov. 1914).

21. **A. leiostachyum** (Benth.) comb. nov.; *Salicornia leiostachya* Benth. Fl. Austr. V (1870) 203. (Pl. V., fig. 2).

Shrubby, articles thickened upwards, shortly and bluntly bidentate, with scarious margins. Even between the nodes bearing ripe spikes the internodes are still covered by assimilatory tissue.

Ripe spikes nearly sessile, 1—3 cm long, 0.5—0.7 cm thick, blunt, cylindric or tapering upwards, with oblique depressed rings and no acuminate points. When the spike is broken, the fruiting perianth remains with the article below it. Flowers in threes, wholly immersed, perianth flattened above, without indentations. Ripe pericarp hard and brown, compressed, seen from the side broadly ovate (Fig. 24*e*); style withering, not persistent. Radicle below, albumen lateral.

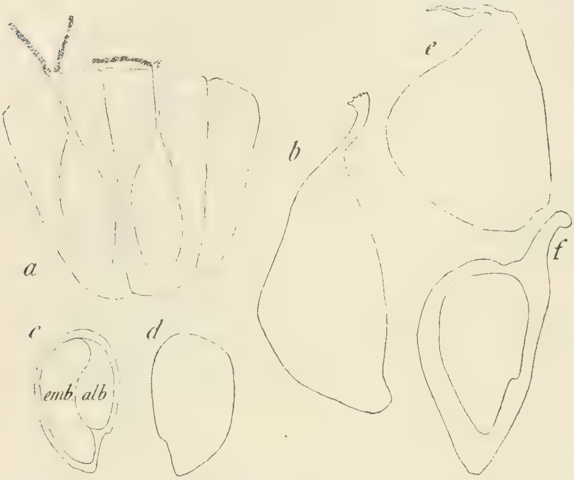


Fig. 24. *a—d, Arthrocnemum Benthami. a*, 3 fruiting perianths, the one on the right hand lacks ovary. *b*, outline of ripe fruit. *c—d*, seeds (emb., embryo, alb., albumen). *e*, outline of fruit of *A. leiostachyum*. *f*, same of *A. indicum*. About $^{10}/_{1}$.

This species has been identified from BENTHAM's description only. It is, if rightly understood, nearly related to *A. indicum* (Willd.) Moq. (Pl. V, fig. 3). Of the last-named species we have in Copenhagen specimens collected by ROTTLER on the plains at Tranquebar and thus properly identical with those seen by WILLDENOW. They differ in the shape of the ripe fruit. In *A. indicum*, the style is persistent like the rest, and placed obliquely (see Fig. 24, *f*), and the pericarp is obovate. As stated by UNGERN-STERNBERG (Versuch einer Systematik d. Tribus Salicornieae, Diss. Dorpat 1866, p. 70), the pericarp is easily fissuring in the sagittal plane. Were it not for these differences, the two species would seem to be identical. A study of a larger material, however, might perhaps reveal other differences.

Port Hedland (No. 1144 bis, 3. Nov. 1914).

22. **A. Benthami** n. sp. (Pl. VI, fig. 2).

Fruticosum erectum carnosum ramis oppositis internodiis superne vix dilatatis margine scarioso bifido lobis acutiusculis. Spicæ 0.8—2 cm longæ maturæ 0.4—0.5 cm crassæ breviter vel longiuscule pedunculatæ 8—12 articulatæ, articulis brevibus in

spicis junioribus margine scarioso leviter bifido, in spicis maturis lineis depressis leviter curvatis limitatis, curvaturis binis superioribus convexis oppositis in dentibus minutis productis.

Flores terni immersi articulo superiori arcte adhaerentes, perianthio superne dilatato edentulo, stamine uno anthera ad medium lobata, pericarpio indurato brunneo ovato-lanceolato, semine uno radicula infera albumine laterali (Fig. 24 *a*—*d*).

This species distinguishes itself from the preceding by the following characters: The stem bearing ripe spikes has as a rule lost its assimilatory tissue, the spikes are smaller, and the rings between the articles bear small acumens, the shape of the ripe pericarp is different, and the style is persistent. It may be that this is the true *A. leiostachyum*. The two species were collected in the same place and at the same time; Dr. OSTENFELD took them for the same species. He remarks that *A. Benthami* forms coarse flat cushions. On the other hand, a Berlin specimen is labelled: about 3/4 m high. Dr. OSTENFELD has observed that broken off spikes of this and the foregoing species are carried by the wind, and thus sow out the seeds.

Point Samson (Cossack), outskirts of Mangrove (No. 1143, 2. Nov. 1914); Port Hedland, dune depression (No. 1144, 3. Nov. 1914). In the Berlin herb. the species is present from: Carnarvon (L. Diels, No. 3739), and South Austr., Port Adelaide, leg. J. G. O. Tepper.

23. **A.** (?) **bidens** Nees ab Esenbeck, in Lehm. Pl. Preissianae I (1845) 632; Moq. in D. C. Prodr. XIII 2 (1849) 151; *Salicornia bidens* Benth. Fl. Austr. V (1870) 203.

A sterile specimen only. It has been named on account of its relatively long and distinct foliar scales. Fruit and seed are not known, and thus it remains doubtful to which genus our species belong. — PREISS' original specimen was also from Swan River.

Swan River at Perth (No. 340 A, 6. Sept. 1914, E. DORPH-PETERSEN).

24. **A.** (?) **pruinosum** n. sp. (Pl. VI, fig. 3).

Erectum fruticosum ramosissimum ramis oppositis ramulorum articulis pruinoso-glaucis 1 cm brevioribus apice scarioso-dilatatis, lobis 2 oppositis quam collo laterali paullo majoribus acutatis vel angulatis. Spicæ 1—3.5 cm longæ 8—17 articulatæ articulis brevibus superne scarioso-dilatatis margine fere annularibus. Flores

terni non cum foliis cohærentes brevissime exserti, perianthio infundibuliformi superne bidentato, stamine uno, pericarpio membranaceo debili. Semina non adsunt (Fig. 25).

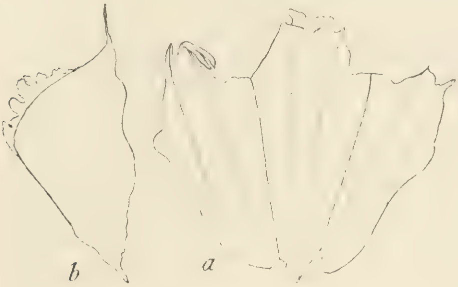


Fig.25. *Arthrocnemum pruinosum. a,* 3 flowers seen from outside. *b*, a flower seen from the left side, with hairs on its top. About $^{10}/_{1}$.

The bluish-green colour and the long spikes with unlobed margins are characteristic for this species. Flowering.

Carnarvon, on the beach (No. 349, 31. Oct. 1914).

25. **A. brachystachyum** n. sp. (Pl. VI, fig. 4).

Erectum fruticosum ramosissimum ramis oppositis ramulorum articulis viridibus (in sicco cinereo-viridibus) 1 cm brevioribus v. longioribus apice dilatatis et in dentes 2 distinctos acutos productis margine anguste scarioso. Spicæ 0.5—1.2 cm longæ ca. 0.3 cm crassæ articulis 4—8 brevibus inferioribus leviter et obtuse lobatis, superioribus margine fere annulari. Flores terni cum foliis non cohærentes, et juniores et vetustiores longe exserti perianthio superne breviter dentato, pericarpio cum stylo indurato brunnescenti semine uno albumine laterali radicula infera. Stamina non adsunt (Fig. 26).

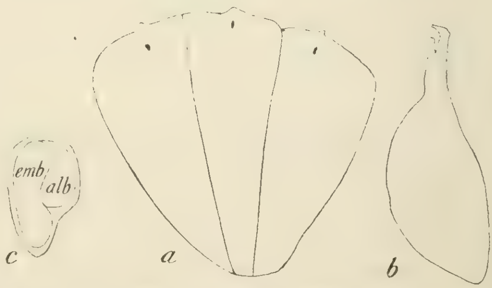


Fig. 26. *Arthrocnemum brachystachyum. a*, 3 fruit-bearing perianths. *b*, ripe fruit. *c*, seed (emb., embryo, alb., albumen). About $^{10}/_{1}$.

Characteristic especially by the shape and appearance of the spikes. Fruiting.

Carnarvon, on the beach (No. 352, 31. Oct. 1914).

## X. Salicornia L.

26. **S. australis** Solander in Forster, Flor. insul. austral. prodrom. (1786) 88; Benth. Fl. Austr. V (1870) 205; *Salicornia indica* R. Br. Prodr. (1810) 411, non Willd.; ? *Halocnemum australasiacum*

Moq. in D. C. Prodr. XIII 2 (1849) 149; *Salicornia quinqueflora* Bge. in Ung. Sternberg l. c. (1866) 59.

A low bluish-green shrub. Flowers in fives, whereby this species is easily recognisable. The specimens have lost their fruits, the axes remaining. Here, then, the spikes are not tumbled about by the wind (comp. *A. leiostachyum*). From the deficiency of fruit and seed it is uncertain whether the species is a *Salicornia*, or an *Arthrocnemum*.

Carnarvon, in salt pans (No. 350, 31. Oct. 1914).

27. **S. sp.**

A slender, sterile specimen.

Swan River at Perth (No. 340 B, 6. Sept. 1914, E. Dorph-Petersen).

## XI. Suæda Forsk.

28. **S. australis** (R. Br.) Moq., Ann. sc. nat. 23, (1831) 318; *Chenopodium australe* R. Br. Prodr. (1810) 407; *Chenopodina australis* Moq. in D. C. Prodr. XIII 2 (1849) 163; *Suæda maritima* Benth. Fl. Austr. V (1870) 206.

The specimens have been named *Suæda maritima* by Mr. J. H. Maiden. They are shrubby below, sterile, having thrown off their fruits, but the branches are shooting freely. Having had no opportunity to examine flower and fruit, I have made cross-sections of leaves. The anatomy of the leaf is, as a whole, like that of *S. maritima* from our North-European coasts, but there is one difference, namely that the epidermis is very papillose on all sides of the leaves[1]. Thus, both the shrubby habit of the plant and the shooting after flowering show that it is perennial, and the papillæ on the leaves give further proof for the assumption that *S. australis*, if derived from *S. maritima*, is no longer identical with it, but must be regarded as a distinct species.

Swan River at Perth (No. 341, 6. Sept. 1914, E. Dorph-Petersen). Derby, dominant in mangrove (No. 1163, 7. Nov. 1914).

29. **S. sp.**

A fragment.

Kalgoorlie (No. 232, 7. Oct. 1914).

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[1] On the value of anatomy in identification of the species of *Suæda*, see the present writer's book: Studies in the Vegetation of the Transcaspian Lowlands. Copenhagen 1912.

## XII. Salsola.

30. **S. Kali** L. Spec. plant. (1753) 222; Benth. Fl. Austr. V (1870) 207.

A somewhat long-leaved and coarse orm. The anatomy of the leaves is like that in northern specimens.

Carnarvon, on sandy beach (No. 353, 31. Oct. 1914); Port Hedland (3. Nov. 1914).

(Issued 22th May 1918.)

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1. *Kochia Ostenfeldii*, from Kalgoorlie. 2. *Arthrocnemum leiostachyum*, from Port Hedland 3. *Arthrocnemum indicum*, from Tranquebar, India. ($^2/_3$ nat. size).


1. *Arthrocnemum Arbuscula*, from Port Hedland. 2. *A. Benthami*, from Port Hedland. 3. *A.* (?) *pruinosum*, from Carnarvon. 4. *A. brachystachyum*, from Carnarvon. ($^2/_3$ nat. size).

Bd. 2 • DANSK BOTANISK ARKIV • Nr. 9
UDGIVET AF DANSK BOTANISK FORENING
1918

# Mosses and Lichens

## collected in the former Danish West Indies

By

**F. Børgesen** and **C. Raunkiær.**

In the years 1905-6 we visited the Danish West-Indies, and from that tour dates the greater part of the material which this list contains. As to the rest of the material most of it is due to F. Børgesen's travellings, respectively in 1892-93 and 1895-96. Finally the list contains some specimens collected by Eggers, O. Paulsen and C. H. Ostenfeld. The whole of the material is in the Botanical Museum University of Copenhagen.

Our warmest thanks are due to the Professors V. F. Brotherus and E. Wainio (Helsingfors), who were kind enough to determine the whole of the material, respectively the mosses and the lichens.

The lichens have been included in Wainio's "Additamenta ad Lichenographiam Antillarum illustrandam" (Annales Academiae Scientiarum Fennicae. Ser. A. Tom. VI. Helsingforsiae 1915). The names of those species collected by us and mentioned in Wainio's paper as new are, in the present list, printed in large type. The mosses, on the other hand, have never been published before. Therefore, by the permission of Professor Brotherus, the new species, there are only two of them, are here accompanied by his descriptions.

The greater part of our collections were chiefly got in St. Jan, the central part of St. Thomas, and the western part of St. Croix. Some of the localities were visited by us together; but, as the chief aim of our investigations in the West-Indies was of a different nature, we had, each of us by himself, opportunities of making collections in places where the other did not go. And, even if we went to the same places it often was at a different time of the year. Still, of course, one must not expect on account

of this that the flora of mosses and lichens have been even moderately explored. A beginning is made, that is all. This is shown, too, as far as the mosses are concerned, by a comparison of our list of mosses with the one made by ELIZABETH GERTRUDE BRITTON[1], based upon collections in 1913. The two lists contain about the same number of species, Miss Britton's 23, ours 24, all of them collected in the Danish West-Indies; but 9 species only are common to both lists, which shows that not even a fourth part of the collected species are common to both lists, these pointly containing the 38 species of mosses now known in St. Croix, St. Thomas, and St. Jan. Four of these 38 species have, up till now, never been found elsewhere, except in the above-mentioned islands, namely: *Hyophila uliginosa* E. G. Britton, *Phascum sessile* E. G. Britton, *Trichostomum perviride* Brotherus, and *Bryum* (Apalodictyon) *Raunkiærii* Brotherus.

Even if the number of species of mosses undoubtedly, in the course of time, will increase greatly, the fact remains that the former Danish West-Indies are as deficient in species as they are destitute of areas covered with mosses. Larger patches of ground covered densely with moss are found only on the higher lands, e. g. Makumbo at St. Jan.

The lichenflora is far richer in species, our list containing 156 species, of which 59 are described as new in the above-quoted work of Wainio. All these species have so far, been found only in the Danish West Indies. Many of the new species live on stones and cliffs in places sprayed by the surf, and one of us, Børgesen, had opportunity of making collections here. Most of the species from this locality have never been described before.

[1] ELIZABETH GERTRUDE BRITTON. West-Indian Mosses. II. Mosses of the Danish West Indies and Virgin-Islands. (Bull. of the Torr. Botan. Club 42. 1915.)

# I. Mosses

Determined by **V. F. Brotherus.**

**Leucobryaceae.**

Octoblepharum albidum (L.) Hedw. St. Thomas: Signalhill (Eggers); St. Jan: America Hill (Raunkiær 340, 350); Esperance (Børgesen); Makumbo (Raunkiær 344).

**Fissidentaceae.**

Fissidens Kegelianus C. Müll. St. Thomas: St. Peter (Børgesen); Crown (Raunkiær 331).

**Calymperaceae.**

Syrrhopodon breviligulatus C. Müll. St. Jan: Bordeaux (Raunkiær 358).

Calymperes disciforme C. Müll. St. Croix: Caledonia Valley (Børgesen); St. Thomas (Eggers).

**Pottiaceae.**

Weisia edentula Sull. St. Croix: Canebay (Børgesen); Kingshill (Raunkiær 334); St. Jan: Foygut (Børgesen); Bordeaux (Børgesen; Raunkiær 343, 372); Rustenborg (Børgesen).

**Trichostomum perviride** Broth. n. sp. Dioicum; caespitosum, caespitibus densiusculis, rigidis, viridibus, haud nitidis; caulis c. 1.5 cm altus, erectus vel adscendens, infima basi parce fusco-radiculosus, dense foliosus, superne plerumque furcatus; folia sicca circinato-crispula, marginibus involutis, humida patentia, stricta, canaliculato-concava, e basi brevi, ovali late lineari-lanceolata, acutiuscula, saepius hyalino-mucronata, rarius obtusiuscula, mutica, marginibus anguste involutis, integris, nervo crassiusculo, continuo vel breviter excedente, dorso laevi, cellulis minutissimis, subquadratis, papillosis, obscuris, basilaribus majoribus, breviter rectangularibus, hyalinis, laevissimis. Caetera ignota.

St. Thomas, Crown, ad terram (Raunkiær 367). Species T. jamaicensi (Mitt.) Broth. affinis, sed foliorum forma facillime dignoscenda.

Hyophila Tortula (Schwaegr.) Hamp. St. Croix: Canaan (Børgesen); Jolly Hill (Raunkiær 365, 371).

Barbula hymenostylioides Broth. St. Croix: Crequis (Børgesen).

Barbula Crügeri Sond. var. laevinervis Broth. n. var. Compacte caespitosa; folia subcucullata, nervo dorso laevi. St. Jan: Hope (Børgesen).

Tortula agraria Sw. St. Croix: Prosperity (Børgesen); Caledonia Valley (Raunkiær 571); Jolly Hill (Raunkiær 564); Northside (Børgesen). St. Thomas: Løvenlund (Raunkiær 563, 568). St. Jan: America Hill (Børgesen, Raunkiær 376).

**Bryaceae.**

Bryum (Apalodictyon) Raunkiaerii Broth. n. sp. Dioicum; caespitosum, caespitibus laxis, faciliter dilabentibus, mollibus, pallide viridibus, haud nitidis; caulis usque ad 2 cm altus, erectus, infima basi parce radiculosus, laxissime foliosus, simplex vel parce ramosus; folia sicca et humida patula, haud decurrentia, cymbiformi-concava, elongate oblonga, obtusa, marginibus erectis, integris vel apice plus minusve distincte obtuse serrulatis, elimbata, nervo tenui, rubello, infra apicem folii evanido, cellulis laxe oblongo-hexagonis, teneris, parce chlorophyllosis, basilaribus elongate rectangularibus. Caetera ignota.

St. Croix, Caledonia, ad rupes pr. cataractam (Raunkiær 572).

Species pulcherrima, statura robusta, colore foliisque remotis, patulis oculo nudo jam dignoscenda.

Bryum Crügeri Hamp. St. Croix: Caledonia Valley (Børgesen).

**Bartramiaceae.**

Philonotis ligulatula (C. Müll.) Par. St. Thomas: Crown (Raunkiær 363).

Philonotis tenella (C. Müll.) Besch. St. Thomas: Løvenlund (Raunkiær 567).

**Erpodiaceae.**

Erpodium domingense (Spreng.) C. Müll. St. Thomas: Løvenlund Gut (Raunkiær 366, 368).

**Leskeaceae.**

Thuidium involvens (Hedw.) Mitt. St. Jan: Debt (Raunkiær 335); Esperance (Raunkiær 348).

Thuidium minutulum (Hedw.) Bryol. eur. St. Jan: Makumbo (Raunkiær 375).

**Entodontaceae.**

Stereophyllum leucostegium (Brid.) Mitt. St. Thomas: Magensbay (Børgesen).

**Hypnaceae.**

Microthamnium thelistegum (C. Müll.) Mitt. St. Jan: Makumbo (Raunkiær 347).

Taxithelium planum (Brid.) Mitt. St. Jan: Bordeaux (Raunkiær 339, 345, 351, 354, 364, 576); Debt (Raunkiær 338, 356, 359); Susannaberg (Børgesen); Makumbo (Børgesen; Raunkiær 574, 575); Esperance (Børgesen; Raunkiær 374); America Hill (Raunkiær cfr. Octoblepharum albidum 340, 350).

Vesicularia vesicularis (Schwaegr.) Broth. var. Poeppigiana (Hamp.) Broth. St. Croix: Crequis (Børgesen); Mount Stewart (Børgesen).

Vesicularia leucoclada (Schimp.) Broth. St. Croix: Mount Stewart Gut (Raunkiær 369, 370).

**Sematophyllaceae.**

Rhaphidostegium caespitosum (Sw.) Jaeg. St. Thomas: St. Peter (Børgesen).

Rhaphidostegium admixtum (Sull.) Broth. St. Jan: Esperance (Børgesen); Debt (Raunkiær 332, 346); Bordeaux (Børgesen); America Hill (Børgesen; Raunkiær 341, 352).

# II. Lichens

Determined by **E. Wainio.**

## I. Discolichenes.

### A. Cyclocarpeae.

Trib. **Parmelieae.**

**Eumitria Antillarum** Wain. St. Thomas: Signalhill (Eggers).

Ramalina gracilis (Pers.) Nyl.* R. Antillarum Wain. St. Thomas: Crown (Raunkiær 435); Mt. St. Peter (Børgesen), Highest Ridge (Eggers).

Ramalina complanata (Sw.) Ach. St. Croix: Judith Fancy (Børgesen); St. Thomas: Signalhill (Eggers).

Parmelia (Amphigymnia) peresta Krempelh. var. flavogranulosa Wain. St. Croix: Mount Stewart (Raunkiær 433).

Parmelia dominicana Wain. St. Thomas: Magensbay Estate (Børgesen), Ma Folie (Biese).

Parmelia crinita Ach. St. Thomas: Signalhill (Eggers), Highest Ridge (Eggers).

**Parmelia Sancta Crucis** Wain. St. Croix: Fair Plane (Børgesen).

Parmelia latissima Fée. var. cristifera (Tayl.) Hue. St. Croix: Mt. Eagle (Børgesen). St. Thomas: Signalhill (Eggers).

Parmelia subcrinita Nyl. (Syn. P Mauriensis Hue). St. Thomas: Crown (Eggers) et alibi (Hornbeck, Børgesen).

Parmelia coralloidea (Mey. & Flot.) Wain. St. Thomas: Signalhill (Eggers), Mt. St. Peter (Børgesen), Crown (Raunkiær 415), s. l. (O. Paulsen); St. Jan: Bordeaux (Raunkiær 462, Børgesen).

Parmelia sulphurata Nees et Flot. St. Thomas: s. l. (Ove Paulsen): St. Jan: Makumbo (Raunkiær 442), Bordeaux et prope Susannaberg (Børgesen).

Parmelia (stirps Cyclocheila) tropica Wain. St. Croix: (Ove Paulsen).

Parmelia martinicana Nyl. St. Croix: Krausses Lagoon (Raunkiær 547); Fair Plane et Judith Fancy (Børgesen).

**Parmelia Raunkiæri** Wain. St. Croix: Cane Bay (Raunkiær 461); Judith Fancy (Børgesen).

Parmelia granatensis Nyl. St. Croix: Krausses Lagoon (Raunkiær 545).

Parmelia (Xanthoparmelia) lusitana Nyl. St. Thomas: Crown (Raunkiær 424); St. Jan: Cruz Bay (Børgesen). Var. decipiens Wain.; Buck Island pr. St. Thomas (Børgesen); St. Jan: Cruz Bay (Børgesen).

### Trib. **Lecanoreae.**

**Lecanora subtilissima** Wain. St. Jan: Reef Bay (Børgesen).

Lecanora cinereo-carnea (Eschw.) Wain. St. Croix: Sandy Point et Cane Bay (Raunkiær 550, 407); St. Jan: Reef Bay (Børgesen).

Lecanora prosecha Ach. var. rubescens Wain. St. Croix: Crequis et Caledonia Valley (Børgesen).

### Trib. **Pertusarieae.**

**Pertusaria coccopoda** Wain. St. Thomas: Mt. St. Peter (Børgesen); St. Jan: Foygut bay, America Hill (Børgesen).

Pertusaria xanthodes Müll. Arg. var. biformis Wain. St. Croix: Cane Bay (Raunkiær 467), Mt. Eagle (Børgesen). Var. stramineo-albida Wain. St. Croix: Northside (Børgesen).

**Pertusaria simplicata** Wain. St. Croix: Cane Bay (Raunkiær 467).

Pertusaria praetervisa Wain. var. straminea Wain. St. Croix: Hams Bluff et Via Oxholmia (Børgesen); Cane Bay

(Raunkiær 425, 426); Buck Island (Børgesen). St. Jan: Brynes Bay (Raunkiær 429); Cruz Bay (Børgesen).

Var. **expallescens** Wain. St. Croix: Hams Bluff et Crequis (Børgesen). St. Jan: Cruz Bay (Børgesen).

Var. **pileolata** Wain. St. Croix: Hams Bluff et Salt River et ad Prosperity (Børgesen).

Pertusaria flavens Nyl. St. Croix: s. l. (Ove Paulsen).

**Pertusaria glaucopunctata** Wain. St. Thomas: Crown (Raunkiær 417).

Trib. **Theloschisteae.**

**Placodium cupuliferum** Wain. St. Jan: Reef Bay (Børgesen).

Placodium cinnabarinum (Ach.) Anzi. Buck Island prope St. Thomas (Rüssl.).

Placordium subfulgescens (Nyl.) Wain. f. dispersa Wain. St. Croix: Caledonia valley (Børgesen); St. Thomas: Magensbay Estate (Børgesen); St. Jan: America Hill (Børgesen).

Placodium aurantiacum (Lightf.) Tuck. *Pl. Bassiae (Willd.) Wain. St. Thomas: Crown (Raunkiær 422).

Placodium ferrugineum (Huds.) Hepp. var. caesiorufa (Nyl.) Wain. St. Jan: Reef Bay et Foygut Bay, America Hill (Børgesen).

Placodium leptozonum (Nyl.) Wain. St. Jan: Reef Bay (Børgesen).

**Placodium Boergesenii** Wain. var. **squamoso-areolata** Wain. St. Thomas: Magensbay (Børgesen); St. Jan: Reef Bay (Børgesen).

Var. **leptozonoides** Wain. St. Croix: Salt River (Børgesen).

**Placodium janinum** Wain. St. Jan: Kebay (Børgesen).

**Placodium agratum** Wain. St. Croix: Hams Bluff et Via Oxholmia (Børgesen).

Placodium diplacioides Wain. St. Croix: Crequis, Mt. Eagle (Børgesen); St. Thomas: Løvenlund (Raunkiær 413). Ma Folie (Biese); St. Jan: Kebay, Esperance et Reef Bay (Børgesen).

Placodium diplacium (Ach.) Wain. var. carneofusca (Nyl.) Wain. St. Croix: Caledonia valley et Crequis (Børgesen); St. Thomas: Løvenlund (Raunkiær 405); St. Jan: Esperance, Kebay et Reef Bay (Børgesen).

Var. phaea (Tuck.) Wain. St. Croix: Crequis, Caledonia valley et Hams Bluff (Børgesen); St. Thomas: Crown (Raunkiær 411), Magensbay Estate (Børgesen), St. Peter (Børgesen); St. Jan: Susannaberg (Børgesen).

Var. verrucosa Wain. St. Thomas: Magensbay Estate (Børgesen); St. Jan: Cruz Bay (Børgesen).

Var. lecideoides Wain. St. Croix: Cane Bay (Raunkiær 427), Via Oxholmi et Prosperity (Børgesen); St. Thomas: Magensbay Estate (Børgesen); Buck Island prope St. Thomas. Transiens in var. verrucosam; St. Thomas: Magensbay Estate (Børgesen); in var. phaeam transiens; St. Croix: Prosperity (Børgesen).

Var. deminuta Wain. St. Thomas: Magensbay Estate (Børgesen).

### Trib. **Buellieae.**

Anaptychia granulifera (Ach.) Wain. var. farinulenta Wain. St. Thomas: Signalhill (Eggers).

Physcia callosa Nyl. var. macra Wain. St. Jan: Cruz Bay (Børgesen).

Physcia integrata Nyl. var. obsessa (Mont.) Wain. f. psathyra (Tuck.) Wain. St. Jan: Cruz Bay (Børgesen).

Var. serediosa Wain. f. tristis Wain. St. Croix: Crequis (Børgesen); St. Thomas: Crown (Raunkiær 402), Magensbay Estate (Børgesen); St. Jan: Reef Bay (Børgesen), Coral Bay (Raunkiær 453); f. pallescens Wain. St. Croix: Fair Plane (Børgesen).

Physcia crispa (Pers.) Nyl. var. mollescens (Nyl.) Wain. St. Croix: Cane Bay (Børgesen); St. Thomas: Løvenlund (Raunkiær 410, 431), Magensbay Estate (Børgesen), Signalhill

(Eggers); St. Jan: Cruz Bay (Raunkiær 554, 556), Reef Bay Makumbo, Susannaberg (Børgesen). f. melanophthalma Wain. St. Thomas: Løvenlund (Raunkiær 541).

Physcia minor (Fée) Wain. St. Croix: Northside (Børgesen).

Physcia adglutinata (Floerk.) Nyl. St. Croix: Cane Bay (Raunkiær 406).

Physcia picta (Sw.) Nyl. St. Croix: Northside (Børgesen) et alibi (Ove Paulsen); St. Thomas: Crown (Raunkiær); St. Jan: Cruz Bay.

Ph. picta (Sw.) Nyl. f. prunifera Wain. St. Croix: Northside (Børgesen); St. Jan: Cruz Bay (Børgesen).

Ph. picta (Sw.) Nyl. f. lavata Wain. St. Croix: s. l. (Ove Paulsen).

**Physcia purpurascens** Wain. St. Croix: Krausses Lagoon (Raunkiær 542), Fair Plane (Børgesen).

Pyxine Meissneri Tuck. var. genuina Malme. St. Croix: Fair Plane (Raunkiær 548), Jolly Hill (Raunkiær 436), Krausses Lagoon (Raunkiær 546), Hams Bluff et Cane Bay (Børgesen), s. l. (Ove Paulsen).

Var. rinodinoides Wain. St. Jan: Coral Bay (Caroline) (Raunkiær 443).

Pyxine connectens Wain. St. Croix: Cane Bay (Raunkiær 406).

Pyxine dissecta (Fée) Wain. St. Croix: Northside (Børgesen), Cane Bay (Raunkiær 406).

Pyxine heterospora Wain. St. Thomas: Løvenlund (f. rugulosa Wain., Raunkiær 409), Crown (Raunkiær 420); St. Jan: Cruz Bay et Reef Bay (Børgesen).

Pyxine obscurascens Malme. St. Thomas: St. Peter (Børgesen).

**Rinodina pyxinoides** Wain. St. Jan: Cruz Bay (Børgesen).

**Rinodina Boergesenii** Wain. St. Croix: Hams Bluff (Børgesen).

**Rinodina Antillarum** Wain. St. Thomas: Magensbay Estate (Børgesen).

**Rinodina intrusa** (Krempelh.) Malme. var. leioplaca (Müll. Arg.) Malme. St. Jan: Reef Bay (Børgesen).

Melanospicilia contiguella Wain. St. Thomas: Magensbay Estate (Børgesen).

Var. vegetior Wain. St. Thomas: Magensbay Estate (Børgesen).

Buellia dejungens Nyl. var. chrysophaea Wain. St. Croix: Hams Bluff et Mt. Eagle (Børgesen); St. Thomas: Magensbay Estate (Børgesen).

Var. chrysochlora Wain. St. Croix: Caledonia Valley (Børgesen); St. Jan: Makumbo et Esperance (Børgesen).

Var. chrysochroa Wain. St. Croix: Mt. Eagle (Børgesen); St. Thomas: Løvenlund (Raunkiær 404); St. Jan: Rustenborg (Børgesen).

**Buellia endochrysea** Wain. St. Thomas: Magensbay Estate (Børgesen).

**Buellia trachyspora** Wain. St. Jan: Reef Bay (Børgesen).

**Buellia gyrosa** Wain. St. Jan: Rustenburg (Børgesen).

**Buellia poliocheila** Wain. St. Thomas: Ma Folie (Biese), Magensbay Estate (Børgesen); St. Jan: Cruz Bay (Børgesen).

Buellia parachroa Wain. var. interrupta Wain. St. Thomas: Magensbay (Børgesen).

**Buellia pachydermatica** Wain. St. Thomas: Ma Folie (Biese).

Buellia conspirans Nyl. St. Jan: Cruz Bay (Børgesen).

Buellia modesta (Krempelh.) Müll. Arg. St. Croix: Fair Plane (Børgesen), Krausses Lagoon (Raunkiær 542); St. Thomas: Crown (Raunkiær 419).

Buellia Lauricassiae (Fée) Wain. St. Croix: Jolly Hill (Raunkiær 436); St. Thomas: s. l. (Børgesen).

Buellia polyspora (Willey) Wain. var. diminutiva Wain. St. Croix: Cane Bay (Raunkiær 467).

**Buellia pachyphragma** Wain. St. Jan: Reef Bay (Børgesen).

**Buellia orcularia** Wain. St. Thomas: Magensbay (Børgesen); St. Jan: Cruz Bay (Børgesen).

### Trib. **Pannarieae.**

Coccocarpia pellita (Ach.) Wain. var. parmelioides (Hook.) Müll. Arg. St. Jan: Esperance et Cruz Bay (Børgesen).

Coccocarpia cronia (Tuck.) Wain. var. isidiophylla (Müll. Arg.) Wain. St. Jan: s. l. (Ove Paulsen).

Var. isidiosa (Müll. Arg.) Wain. St. Thomas: St. Peter (Børgesen); St. Jan: Susannaberg (Børgesen).

### Trib. **Heppieae.**

Heppia Bolanderi (Tuck.) Wain. St. Jan: Cruz Bay (Børgesen).

Leptogium moluccanum (Pers.) Wain. St. Jan: Makumbo (Raunkiær 428, 441).

Leptogium caesium (Ach.) Wain. St. Jan: Esperance (Børgesen).

Leptogium marginellum (Sw.) Mont. St. Thomas: St. Peter (Børgesen).

Leptogium coralloideum (Mey. et Flot.) Wain. St. Jan: Makumbo (Raunkiær et Børgesen).

**Collema** (sect. Blennothallia) **acarosporoides** Wain. Buck Island near St. Croix (Børgesen).

**Synalissa lichinella** Wain. St. Jan: Cruz Bay (Børgesen).

**Pyrenopsis Antillarum** Wain. St. Thomas: Magensbay Estate (Børgesen); St. Jan: Cruz Bay (Børgesen).

**Pyrenopsis negans** Wain. St. Jan: Cruz Bay (Børgesen).

**Psorotichia aspicilioides** Wain. St. Croix: Crequis (Raunkiær 432).

Psorotichia americana Wain. var. pallescens Wain. St. Jan: America Hill (Børgesen).

**Psorotichia Boergesenii** Wain. St. Thomas: Magensbay (Børgesen).

Trib. **Lecideae.**

Cladonia fimbriata (L.) Fr. f. subulata (L.) Wain. St. Croix: Mt. Eagle (Børgesen). f. radiata (Schreb.) Coem. Wain. parce cum praecedente (Mt. Eagle).

Cladonia pityrea (Floerk.) Fr. f. sorediosa Wain. St. Croix: Mt. Stewart (Raunkiær 430).

Lecidea medialis Tuck. Wain. St. Croix: Cane Bay, Mt. Eagle (Børgesen); St. Jan: Makumbo (Børgesen).

**Lecidea subvelutina** Wain. St. Jan: Debt (Raunkiær, 558, 559, 560).

**Lecidea** (Biatorina) **trifera** Wain. St. Croix: Jolly Hill (Raunkiær 440).

**Lecidea** (Biatora) **janina** Wain. St. Jan: Macumbo (Børgesen).

Lecidea piperis (Spreng.) Nyl. f. erythroplaca (Fée) Krempelh. St. Jan: Makumbo (Børgesen); f. circumtincta Nyl. St. Jan: Debt (Raunkiær 454).

### Trib. **Gyalecteae.**

Gyalecta lutea (Dicks.) Tuck. St. Jan: Caroline (Raunkiær 464).

### Trib. **Diploschisteae.**

Diploschistes actinostoma (Pers.) Zahlbr. St. Croix: Mt. Eagle (Børgesen); St. Thomas: Magensbay Estate (Børgesen); St. Jan: Cruz Bay (Børgesen).

### Trib. **Thelotremeae.**

**Thelotrema rhodothecium** Wain. St. Jan: Debt (Raunkiær 403).

Thelotrema compunctum (Sw.) Nyl. var. Antillarum Wain. St. Croix: s. l. (Ove Paulsen); St. Jan: Cruz Bay (Raunkiær 553).

**Thelotrema aquilinum** Wain. St. Croix: Mt. Eagle (Børgesen).

Gyrostomum scyphuliferum (Ach.) Fr. St. Thomas: Crown (Raunkiær 412); St. Jan: Reef Bay (Børgesen), Coral Bay (Raunkiær 449, 451), Borcks Creek (Raunkiær 544).

### Trib. **Lecanactideae.**

**Lecanactis** (Basidiactis) **denticulata** Wain. St. Croix: Krausses Lagoon (Raunkiær 546); St. Thomas: s. l. (Børgesen).

Lecanactis dryina (Ach.) Wain. St. Croix: Fair Plane (Børgesen), Krausses Lagoon (Raunkiær 546).

## B. Hysterieae.

### Trib. 1. **Graphideae.**

**Graphis acuminata** Wain. St. Jan: Esperance (Raunkiær 437).

Graphis virginea (Eschw.) Nyl. St. Jan: Bordeaux (Raunkiær 456), Debt (Raunkiær 403).

**Graphis collospora** Wain. St. Croix: Mt. Eagle (Børgesen).

Graphis punctiformis (Eschw.) Nyl. St. Thomas: Crown (Raunkiær 417).

**Graphis arthonioides** Wain. St. Croix: Krausses Lagoon (Raunkiær 546), Fair Plane (Raunkiær 548).

Graphis trichosa Ach. St. Jan: Debt (Raunkiær 455).

Graphis tenella Ach. var. epiphaea Wain. St. Croix: Cane Bay (Raunkiær 408), Hams Bluff (Børgesen); St. Jan: Coral Bay (Raunkiær 452), Cruz Bay (Raunkiær 557).

Graphis Afzelii Ach. St. Jan: Debt (Raunkiær 466).

Graphis atroalba Krempelh. St. Jan: Debt (Raunkiær 458).

**Graphis** (sect. Anomographe) **coriacea** Wain. St. Croix: Caledonia Valley (Børgesen).

Graphis (sect. Glyphis) cicatricosa (Ach.) Wain. var. simplicior Wain. St. Thomas: Crown (Raunkiær 416); St. Jan: Coral Bay (Raunkiær 447).

Var. confluens (Zenk.) Wain. St. Jan: Coral Bay (Raunkiær 447).

Opegrapha (subg. Euopegrapha) cylindrica Raddi. St. Thomas: Mesgin Estate (Børgesen).

**Opegrapha obvelata** Wain. St. Croix: Little Princess (Ove Paulsen).

Opegrapha interalbata Nyl. St. Jan: Cruz Bay (Raunkiær 555).

Opegrapha brachycarpoides Wain. St. Croix: Kingshill et Little Princess (Børgesen).

**Chiodecton** (Enterographa) **substellatum** Wain. St. Croix: Mt. Eagle (Børgesen).

**Chiodecton endorhodum** Wain. St. Jan: Debt (Raunkiær 403).

Chiodecton sanguineum (Sw.) Wain. St. Jan: Cruz Bay (Raunkiær 553).

Chiodecton (Mazosia) granulare (Müll. Arg.) Wain. St. Jan: Debt (Raunkiær 559, 560).

Arthonia nebulosa (Müll. Arg.) Willey. St. Jan: Borcks Creek (Raunkiær 544).

**Arthonia lignicola** Wain. St. Jan: Bordeaux (Raunkiær 459).

**Arthonia americana** Wain. St. Jan: Bordeaux (Raunkiær 438).

Arthonia substellata (Ach.) Nyl. St. Croix: Little Princess (Ove Paulsen and Børgesen), Sandy Point (Raunkiær 551).

**Arthonia minuta** Wain. St. Croix: Little Princess (Ove Paulsen).

**Arthonia aquilina** Wain. St. Croix: Mt. Eagle (Børgesen).

Arthonia platyspilea Nyl. St. Croix: Cane Bay (Børgesen); St. Thomas: s. l. (Børgesen).

Arthonia perpallens Nyl. St. Croix: Mt. Eagle (Børgesen).

Arthonia subrubella Nyl. In insulis Danicis Indiae Occidentalis 1905—06 (Børgesen).

Arthonia rubella (Fée) Nyl. St. Thomas: Northside Bay (Børgesen), Crown (Raunkiær 418).

Arthonia gregaria (Weig.) Koerb. var. tumidula Almq. St. Jan: Bordeaux (Raunkiær 459).

**Naevia subvelutina** Wain. St. Jan: Debt (Raunkiær 559).

## II. Pyrenolichenes.

Verrucaria aethioboliza Nyl. St. Croix: Crequis (Børgesen).

Parmentaria astroidea Fée. St. Croix: Mt. Eagle (Børgesen).

Thelenella (Microglaena) brasiliensis (Müll. Arg.) Wain. St. Thomas: Magensbay Estate (Børgesen); St. Jan: Reef Bay (Børgesen).

*Bottaria ochraceoflavens (Nyl.) Wain. St. Croix: Fair Plane (Børgesen); St. Jan: Coral Bay (Raunkiær 448, 450).

Bottaria libricola (Fée) Wain. St. Croix: Krausses Lagoon (Raunkiær 543).

**Pyrenula glabrescens** Wain. St. Croix: Mt. Eagle (Børgesen).

Pyrenula laevigata Pers. var. microspora Wain. St. Croix: Little Princess (Ove Paulsen); St. Jan: Makumbo (Børgesen).

Pyrenula cerina (Eschw.) Müll. Arg. St. Croix: Krausses Lagoon (Raunkiær 543), Sandy Point (Raunkiær 549), Salt River (Børgesen), s. l. (Ove Paulsen).

**Pyrenula circumfiniens** Wain. St. Thomas: Crown (Raunkiær 401).

Porina (Segestria) rudiuscula (Nyl.) Wain. var. granulatula (Nyl.) Wain. St. Jan: Makumbo (Børgesen). Var. tetraspora Wain. St. Jan: Debt (Raunkiær 403).

Porina (Segestria) nucula Ach. var. nucalis Wain. St. Croix: Mt. Eagle (Børgesen); St. Jan: Makumbo (Børgesen).

**Porina** (Segestria) **isidiophora** Wain. St. Thomas: Crown (Raunkiær 401); St. Jan: Debt (Raunkiær 454), Bordeaux Hill (Raunkiær 439).

Porina (Segestria) Tetracerae (Ach.) Müll. Arg. St. Jan: Bordeaux Hill (Raunkiær 439).

**Porina** (Sagedia) **glaucopallida** Wain. St. Jan: Makumbo (Børgesen).

**Porina** (Sagedia) **buellioides** Wain. St. Jan: Kebay et Susannaberg (Børgesen).

**Porina** (Sagedia) **Bucidae** Wain. St. Thomas: Mesgin Estate (Børgesen).

**Porina** (Sagedia) **crequisina** Wain. St. Croix: Crequis (Børgesen).

Strigula (Melanothele) argentea (Fée) Wain. St. Croix: Caledonia valley (Børgesen).

Strigula elegans (Fée) Müll. Arg. St. Croix: Caledonia valley (Børgesen).

**Arthopyrenia Antillarum** Wain. St. Jan: Makumbo (Børgesen).

**Arthopyrenia insularis** Wain. Ad corticem arboris in Insulis Danicis Indiae occidentalis (Borgesen annis 1905—1906:).

**Arthopyrenia subinsularis** Wain. St. Croix: Mt. Eagle (Børgesen).

Didymella Cinchonae (Ach.) Wain. St. Thomas: s. l. (39: H. F. A. Eggers).

**Microthelia leucothallina** Wain. In Insulis Danicis Indiae occidentalis (Børgesen annis 1905—06).

Didymosphaeria detincta (Nyl.) Wain. St. Jan: Reef Bay (Børgesen).

### Lichenes imperfecti.

Lepraria xanthina Wain. St. Croix: Belvédère (Børgesen), Mt. Stewart (Raunkiær 444).

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# I. The Pollination of Asclepias cornuti Dcne.

By
**Holger Jørgensen.**



## 1.

None of the descriptions of the pollination of *Asclepias cornuti*, which we have got, are quite satisfactory as regards the conditions of the insects, because none of them are founded upon direct observations.

The foundation of most of the descriptions is evidently confined to an observation of where upon the insect the corpusculum (Corry) [the stigmatic gland (Rob. Brown), Klemmkörper of the German authors] is fixed. In the work by Hildebrandt (1) and in contemporary works by Müller (2) and others, as well as in a later work by Corry (3), the pollinating insect is said to get its foot into the fissure of the anthers (alar chamber (Corry), Germ. Narbenkammer) below, so that the foot is drawn up through the latter, by which means the corpusculum fixes upon one of the claws of the foot. It is, however, easy to see that the foot of the insects, we are here concerned with, is too big to be drawn up through the fissure of the anthers. So it is only from the situation of the corpusculum upon the insect that the above-mentioned investigators have judged about the whole condition of the insect during the pollination. Moreover the observation of the situation of the corpusculum is most probably erroneous. In recent literature sufficient information is found to make it a matter of doubt whether the corpusculum is able at all to be fixed upon a claw. Neither Hildebrandt nor Müller has given any illustration of legs of insects with corpuscula. It is true that Corry has done so; but in the first place it is the foot of a fly, which is figured, though he, as well as the earlier investigators, has found that bees are the only pollinators, and, secondly, the corpusculum upon this foot of a fly is fixed, not upon a claw, but upon one of the pulvilli.

The only naturalist, who has made a closer study of the conditions of the insect during the pollination, is ROBERTSON (4), who studied the pollination in America; but not even ROBERTSON tried any direct observation. His results were got by the examination of the pollination of a species of *Asclepias* with greater flowers, *Asclepias Sullivantii.* In this species R. often found hive-bees captivated, and he then noticed that the insect did not stick with the whole of its foot in the fissure of the anthers but with one claw or the pulvillus. R. then assumed the case to be the same in other species of *Asclepias*, e. g. in *A. cornuti*, viz. that the insects do not get the whole of the foot into the fissure of the anthers, but only the part upon which the corpusculum fixes. In the case of *A. cornuti* it is stated that the corpuscula may be found upon the claws of the insects, upon the pulvillus and the stiff hairs of the foot.

The last data, as far as I am aware, about the pollination of *Asclepias cornuti* are found in Zander's "Die Biene" from 1913, rather an exoteric work. ZANDER holds that the corpusculum always fixes upon the pulvillus, and figures the foot of a bee with the corpusculum fixed there. The extraction of the pollen-mass apparatus is described as follows: the insect gets its foot into the fissure of the anthers, and when the foot has got a little way up, it slips out, and the pulvillus gets up into the corpusculum. This description is not adequate, as it is not easy to understand, why the pulvillus should just get hold of the corpusculum, when the foot had got out of the fissure of the anthers.

All existent works agree about the question, which insects perform the pollination: it is everywhere hymenopters:

| | Apis mellifica | Bombus (several species) | Coelioxys (several species) | Scolia (several species) |
|---|---|---|---|---|
| DELPINO | × | × | | × |
| MÜLLER | × | × | × | |
| HILDEBRANDT | | × | | |
| CORRY | × | × | | |
| ROBERTSON | × | × | | |
| ZANDER | | × | | |
| In the bot. gard. of Copenhagen | | × | | |

Further there is unanimity that the insects perform the pollination by means of the foot. The foot of the pollinating insects is built alike, ending in two moveable claws, between which there is a little plate, the pulvillus.

As there does not exist any investigation of the pollination of *Asclepias cornuti* as yet, founded as far as possible upon direct observations, it may be to the purpose to bring one forward in order quite to elucidate the question.

2.

First we must emphasize the difficulty of a direct perception of the details during the pollination, the pollinating insects moving very quickly and restlessly from flower to flower; but so much the more carefully one ought to observe the facts of the pollination that really are to be seen, and the features of the structure of flower and insect which are of importance at the pollination.

From a minute examination of the insects, humble-bees, which in the botanical garden of Copenhagen pollinate *A. cornuti*, it appears that the corpusculum may be fixed in two places, viz. upon the proboscis, where the corpusculum encloses the utmost joint of the palp of the lower-lip (*Palpus labialis*), and upon the foot, where the corpusculum is fixed upon the pulvillus, the small plate between the two claws of the foot. The proboscis is of no importance to the pollination. Hildebrandt and Müller do not mention any corpuscula at all upon the proboscis, and in the bot. garden of Copenhagen corpuscula may, as mentioned above, be found upon probosces of insects; but in the first place it is much more seldom to find corpuscula upon the proboscis than upon the foot, secondly the pollen-masses have seldom been removed from corpuscula fixed upon the proboscis. As to the position of the corpusculum upon the foot, opinions have been divided. H. Müller for instance believed the corpuscula to be fixed upon the claws, whereas N. E. Brown in a foot-note to Corry's text states that the claws are of very little importance at the extraction of the corpusculum, and Robertson holds that the corpusculum may be fixed upon the claws, upon the pulvillus, and upon the stiff hairs of the foot. The most recent investigator, Zander, has always found the corpusculum fixed upon the pulvillus, and this agrees with my own observations. On an examination of the literature, one might hesitate to take Zander's statement of the position of the corpusculum to be of universal validity; but for one thing the literature proves that it is not easy summarily to observe where upon the foot of the insect the corpusculum is placed, for we may not, I suppose, take it that Müller really always found the corpuscula fixed upon the claws, when Zander, who, even as Müller did, studied the pollination in Germany, always, and

several other investigators often have found the corpusculum fixed upon the pulvillus. Without a microscopic observation, at any rate, it cannot be decided, where the corpusculum is fixed, and we may add that this observation must be very careful. At a cursory observation under the microscope, it may often appear as if the corpusculum is fixed upon a claw, even if it is fixed upon the pulvillus. Nevertheless one ought perhaps to accept the various observations of the situation of the corpusculum upon the foot of the insect as holding good severally, if it were not possible to approach the question still more, viz. by trying if it is possible to fix the corpusculum upon a claw. It is easy enough to make the experiment by passing a claw up through the fissure of the anthers. By this experiment one may, it is true, pull out the corpusculum, but I at least have never succeeded in making the corpusculum fix upon a claw. The reason of this I believe to be, partly, that a certain flexibility of an organ is required to enable it to pass up through the fissure of the corpusculum, the edges of the latter over lapping, and this flexibility the stiff claw does not possess, partly, that the claw most probably is too clumsy to be able at all to pass through the tiny fissure of the corpusculum.

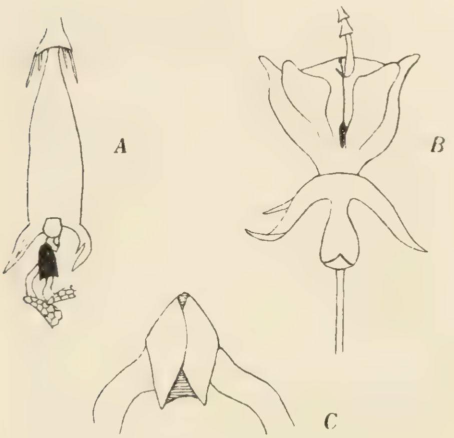


Fig. 1.

*A*. Foot of humble-bee with corpusculum. The foot is seen from below × 3. *B*. Flower of Asclepias cornuti, upon which the foot of a humble-bee has been placed in the position which it occupies, when the humble-bee is extracting the corpusculum. × 20. *C*. Corpusculum seen from the outside. × 50.

It remains to discuss Robertson's finding corpuscula upon the stiff hairs of the foot. None of the naturalists, who have in Europe examined the insects that pollinate *A. cornuti*, have found corpuscula upon the stiff hairs of the foot of the insect. In the bot. garden of Copenhagen I found corpuscula fixed upon the foot of bees above the claws; these corpuscula, however, were not fixed directly upon the stiff hairs, but upon appendages of corpuscula of *Asclepias incarnata*, which were in their turn fixed upon the stiff brushes. The species *A. incarnata* is growing next to *A. cornuti*. *A.*

*incarnata* is pollinated by humble-bees, just as *A cornuti*, and its corpuscula are extracted by means of the stiff hairs of the foot of the insect. When an insect flies from *A. incarnata* over upon *A. cornuti*, the corpusculum of the latter will get fixed as mentioned. *A. incarnata* is an American species, which in America grows in the same places, and gets pollinated by the same insects, as *A. cornuti*. This may probably be the reason of ROBERTSON's observing the corpusculum of *A. cornuti* upon stiff hairs; for the same thing which is true of the claws is also true of the stiff hairs, viz. that it is impossible by experimenting to make corpuscula fix upon them.

By this it has been made probable that the corpusculum always is fixed upon the pulvillus, presumably because this part of the foot is the only one, which fits in with the fissure of the corpusculum — so that the pulvillus is of vital importance for the extraction of the corpusculum and thus for the pollination. It remains to show how the insect gets the corpusculum fixed upon the pulvillus. A comparison between the foot of the insect and the fissure of the anthers proves that the foot of the insect cannot possibly enter into the fissure of the anthers. This becomes the more conclusive, if we consider that the pollinating insect always catches hold with extended claws, and this it may be perceived to do. At the outset it might appear to be difficult for the insect to get the corpusculum fixed upon the pulvillus, but the structure of the flower is such that the pulvillus by the movements of the foot of the insect will invariably be passed into the corpusculum. If we pass the foot of an insect upwards upon the flower, in such a way that the two claws pass upon the outside of the fissure of the anthers, while the pulvillus is inside the fissure (vid. Fig.1), the corpusculum with the pollen-masses will be extracted, and a subsequent microscopic examination will prove the corpusculum to be fixed upon the pulvillus. If we are beforehand familiar with the movement which the insect must make to perform the pollination, we may sometimes see it performed by living insects, especially by such as, for one reason or another, are crawling slowly about upon the flowers. On such occasions we may also see that the insect itself determines whether it will put the pulvillus quite into the stigmatic gland, or remove its foot, before the pulvillus gets as far, so that the term, which several naturalists favour, viz. that the foot is caught in the fissure of the anthers, is not quite correct.

The pollination of the *Asclepias cornuti* is consequently, at least in Europe, performed in the following manner. When the pollinating insects, humble-bees and a few other hymenopters, move

about upon the flowers, they catch hold with extended claws and thus clutch the fissure of the anthers. When the insects next remove the foot, while keeping hold of the fissure of the anthers, the pulvillus is passed through the fissure of the anthers up into the corpusculum, and gets the latter fixed upon it (ROBERTSON, ZANDER and others). The corpusculum with the pollen-masses having been extracted, the appendages turn, so that the pollen-masses, during the moving about of the insects upon the flowers, constantly turn the edge, in which the chink of the pollen-mass is formed, towards the fissure of the anthers (HILDEBRANDT), by which means the pollen-mass is placed with the chink-forming edge in towards the stigma (ROB. BROWN). It is the pollen-mass alone, which is pulled up into the fissure of the anthers (ROBERTSON); we must, however, add that the whole of the pollen-mass apparatus also may be pulled up into the fissure of the anthers, which explains that the corpuscula may sometimes be found fixed inside the fissure of the anthers towards the stigma. After that the pollen-masses have been torn off, the remnants of the appendages fixed upon the corpuscula will act, as the pulvillus did before, by which means the insect may happen to become encumbered with the curious dichotomous combination of corpuscula (HILDEBRANDT).

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# II. Some Remarks on the Germination of the Pollen-mass and the Growth of the Pollen-tubes in Asclepias cornuti Dcne.

By

**Holger Jørgensen.**

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## A.

## The Formation of the Chink of the Pollen-mass in Asclepias cornuti and in Asclepias incarnata.

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### 1.

The pollen-mass of *Asclepias* germinates, as is known, by the formation of a chink, through which all pollen-tubes grow out, in the blunt projection of the pollen-mass.

Ehrenberg (1) and Brown (2) have first observed the chink and the relation of the pollen-tubes to the same, and that the chink is formed in nutrient solutions as well as in the alar chamber has been proved by Brown and later by Corry (3). Both Brown and Corry sought, though in vain, for some peculiarity in the wall of the projection, pores or the like by which to explain the formation of the chink. Neither of these investigators, the only ones, as far as I know, who have been engaged about the reason of the formation of the chink, have proceeded further than to search for a differentiation of the wall of the pollen-mass. So they presumably held that the reason of the formation of the chink is the penetrating of liquids into the pollen-mass through the wall of the projection of the pollen-mass; but they have not proved this, and even by such proof the reason of the formation of the chink has not been explained.

The pollen-mass seems by its characteristic form, by the manner in which the pollen-tubes issue from it, and by the disengagement of the inner grains of pollen from each other during the germination, to be a unity, where the separate grains are subordinated to the whole. So it will be natural to speak of the germination of the pollen-mass, and of the wall of the pollen-mass. As the single grains of pollen, however, when isolated, which may be

effected by cutting the pollen-mass, germinate just as well as when they are in the pollen-mass, the latter must principally be regarded as a group of grains of pollen which have however remained so coherent as to have kept common walls. Thus the form of the pollen-mass is due to the grains of pollen being arranged in a characteristic manner, and the wall of the pollen-mass is in reality nothing but a mosaic of the walls of the grains of pollen. Consequently the chink

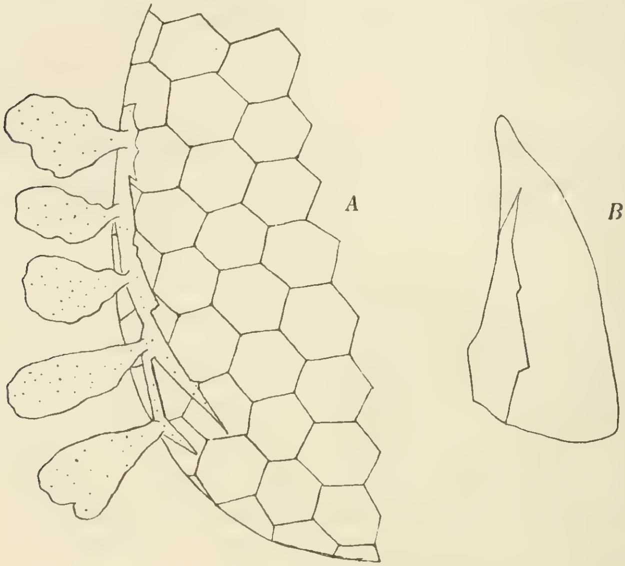


Fig. 1.

*A*. The part of the pollen-mass of Asclepias incarnata, in which the fissure is formed, shortly after the pollen-mass being put into water. *B*. Pollen-mass of Asclepias cornuti with its fissure. Here, as in the following Figs., the walls between the grains of pollen have been left out.

must be taken to be a bursting of the outer walls of the grains of pollen that form the projection. After the bursting, the pollen-tubes of these grains grow out through the chink thus formed. During the germination, the inner grains of the pollen-mass gradually detach themselves from one another, so that all the grains of the pollen-mass may send their pollen-tubes out through the chink.

The chinks being formed by bursting is already seen by the fact that its edges are quite keen (vid. Fig. 1), and further it is seen quite clearly in the closely related species, *Asclepias incarnata*; for in this species the chink is formed so to speak instantaneously on the pollen-mass being put into water. At the same time it is quite

obvious in this species that the chink is made on account of turgor in the grains of pollen, as the protoplasm of the grains of pollen, in whose walls the chink is formed, is squeezed through it immediately after its formation (vid. Fig. 1).

In the *Asclepias cornuti* the chink is not formed until long after the liquid, in which the pollen-mass is put, has penetrated, so that all the grains of pollen become turgid, before the bursting takes place.

Our object is now to show, why only the grains of pollen, that form the projection of the pollen-mass, burst open their free surface, while the rest of the grains of pollen, which help to form the surface of the pollen-mass, send their tubes into the pollen-mass, and from this out through the chink.

## 2.

Brown and Corry assumed there being some peculiarity in the wall of the pollen-mass of the projection, and, in fact, there is a difference between the wall of the projection and the rest of the wall of the pollen-mass. This difference may be made visible by dyeing with aniline dyes. If we examine a pollen-mass, which has been lying only a few moments in a safranine or some other solution of aniline dyes (of other aniline dyes I have tried neutral red, methyl green and methyl blue and all gave the same result) it will be seen that the wall of the projection has been dyed intensively, while the rest of the wall of the pollen-mass has not yet become dyed (vid. Fig. 2). Only on remaining in the solution of colour for a longer time, the whole of the wall of the pollen-mass is dyed. From the wall of the projection, the coulouring-matter soon enters into the pollen grains within, and hence into the pollen-mass, of which fact we may convince ourselves by crushing the pollen-masses, which have been lying in the solution for a shorter or a longer time. Thus the wall of the pollen-mass of the projection proves to absorb aniline dyes sooner, and to let them pass through more quickly, than does the rest of the wall of the pollen-mass[1]).

Fig. 2.

[1]) I shall here take the opportunity of mentioning a few reactions of colour in the wall of the pollen-mass. In bases the wall of the pollen-mass is dyed a reddish-brown; the colour disappears again in water, and more rapidly in dilute acids. In strong sulphuric acid the wall of the pollen-mass becomes a deep red. The colour disappears in a weaker acid and in water, but reappears on the pollen-mass being replaced

Besides, the rapid penetration of fluids into the pollen-grains of the projection may be proved in another way. Pollen-masses are, immediately on being taken out of the flower, yellow to the naked eye, owing to the colour of the wall of the pollen-mass; but under the microscope they prove to be greyish and opaque. Their greyish appearance is due to the water in the pollen-grains, for on remaining exposed to the air the greyish appearance is lost; it reappears however on the pollen-mass being placed in a vessel saturated with vapour. Desiccated pollen-masses appear to be yellow also under the microscope, besides being pellucid, owing to an oil in the grains of pollen. If a desiccated pollen-mass is put into water or in a vessel saturated with vapour, the pollen-mass is seen under the microscope to become greyish, first where the chink is later on formed, and the greyish appearance from there to spread into the pollen-mass.

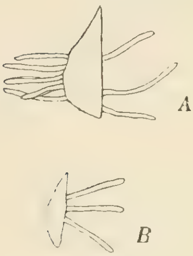

Fig. 3.

Thus liquids are proved to penetrate most rapidly into the grains which are lying just inside the chink, and to penetrate from here quickly into the other grains of the pollen-mass. Further it is shown that the difference in penetrability in the different parts of the wall most probably is related to a difference in the chemical nature; but by this the cause of the formation of the chink has not been found; for we must here emphasize that the chink of the pollen-mass in *Asclepias cornuti* when being upon the stigma or in strong sugar solutions, is not made until long after the surrounding liquid has penetrated into the pollen-mass, so that all the grains are able to become turgid before the chink is formed. So the formation of the chink cannot be due to the fact, that the chink-forming grains of pollen become turgid before the rest of the grains of pollen.

The joint pressure of the grains of the pollen-mass is of no consequence for the formation of the chink. Sections of pollen-masses containing the chink-forming grains of pollen, form the chink in sugar-solutions and do so as quickly as an uninjured pollen-mass (vid. Fig. 3 A). It must however be added that the sections, if very small, form no chink (vid. Fig. 3 B). Moreover the chink is not formed

in strong sulphuric acid. In pollen-masses, which have been lying in strong sulphuric acid, and are then placed in bases, the deep red colour first goes, and then the reddish-brown base-colouring appears. Molisch (4) has discovered that the extine of the pollen grains of certain Compositæ are dyed a deep red with concentrated sulphuric acid.

in its whole length at once, it appears to be the separate grains of pollen which gradually extend the chink. Sometimes one may also find in the alar-chamber pollen-masses, which have as yet formed only a tiny chink, through which a single pollen-tube has grown out, even as the pollen-masses of certain *Asclepiadeæ* do not open by a chink but by pores i. e. by several smaller chinks.

Accordingly it is the pollen-grains of the projection only, which form the chink. Now the question is, what qualities in these grains of pollen are the cause of the chink.

The thickness of the wall of the pollen-mass is the same throughout the whole. It is true that the part of the wall of the pollen-mass, in which the chink is formed, is dyed more quickly with aniline dye than the rest, but also the very hard resinous appendages are dyed very quickly with aniline dyes. Thus nothing in the construction of the wall, as far as it is known, indicates that the part of the wall of the pollen-mass, in which the chink is formed, should be weaker than the rest of the wall. An explanation of the formation of the chink founded upon a fact which cannot be proved is however unsatisfactory, especially if some other explanation may be found.

In the species *Asclepias incarnata* the chink is formed, as mentioned above, almost instantaneously on the pollen-mass being put into water or into weak sugar-solutions, and immediately after the formation of the chink the protoplasm of the grains of pollen which form the chink is squeezed through it. But after the first burstings have taken place, the bursting in the pollen-mass becomes weaker and weaker, and eventually no bursting of any grain of pollen seems to take place. Now it cannot be taken for granted that the outer walls of the inner grains of pollen are stronger than those of the chink-forming ones, and reacting against water and aniline dyes in the same way as these. Now we must assume that the grains of pollen which form the chink, at any rate in the beginning of the germination are able to apply a greater osmotic pressure than the rest of the grains, and that the chink is due to this pressure, rather than assuming differences in the strength of the walls to be the reason of it. Moreover — in the case of *A. cornuti* as well as of *A. incarnata* — the chink-forming grains of pollen, on the concentration of the solution of sugar or of glycerine in which it is lying being intensified, keep the greyish appearance, which is due to content of water, longer than the rest of the grains of the pollen-mass.

We have proved, first, that the formation of the chink is due only to the pollen-grains of the projection of the pollen-mass, secondly, that there is nothing to indicate that the wall of the pollen-mass

should be weaker in the place where the chink is formed than the rest of the wall, — finally it has been shown to be probable that between the chink-forming grains of pollen and the rest of the grains of the pollen-mass there is the difference that the chink-forming grains of pollen at any rate in the beginning of the germination are able to apply a greater osmotic pressure than the rest of the grains.

An inner differenciation in the pollen-mass corresponding to the differenciation of the wall of the pollen-mass was to exist according to this theory. The pollen-grains of the projection were to be distinguished not only by their walls absorbing water and aniline-dyes rapidly, but also by being able themselves to become more turgid than the rest of the grains of the pollen-mass.

The explanation of the formation of the fissure given here is founded upon the acceptance of a fact to be met with elsewhere in the vegetable world. Lidforss (9) and others have pointed out in the case of several plants that on the grains of pollen from the same anther being placed in water, a certain percentage of the grains of pollen burst, while the rest do not become so turgid as to burst, and it must here be called in mind that at any rate in the cases where the bursting comes to pass by the protoplasm being squeezed out through the germ-pores differences in the strength of the exine cannot possibly be of any consequence. In the two species of *Asclepias* with which we are here concerned, the pollen-grains that are able to become most turgid were then to form the projection of the pollen-mass.

B.

## The Germination of the Pollen-grains and the Growth of the Pollen-tubes.

Robert Brown (2), who is the first to have studied the germination in culture of the pollen-mass of *Asclepias cornuti*, found that the pollen-mass is able to germinate well upon the stigma of *Orchis*, but badly in dilute sugar solutions. Corry (3) for his experiments in germination used 5 per cent cane-sugar solutions, and found that the germination proceeds badly by a concentration of that sort, and that in front of the chink a viscid matter is formed, through which a few pollen-tubes grow out. By way of completeness I shall

mention GAGER (5), who likewise used a 5 per cent cane-sugar solution and slices of sugar-beet, but did not follow the development of the pollen-tubes in culture beyond the very first stage. On the pollen-masses of other species of *Asclepias* we have a quite short paper by HALSTED (6). According to HALSTED the pollen-masses of these species germinate in cane-sugar solutions, the concentrations of which are between 1 and 100 per cent, and best in a middling concentration, e. g. at 65 per cent in the case of *A. verticillata.* In HALSTED as well as in BROWN a further statement as to what is meant by a good germination is wanting. Most probably it means that the pollen-tubes grow out from the pollen-mass and attain to a considerable length. I shall use the term "good germination" to denote the above-mentioned conditions.

Presumably the experimenters, mentioned above, cultivated their pollen-masses in rather big cups, that is, in a considerable quantity of liquid. This is a mode of cultivation, which comes natural, when one has to do with these rather big objects, and in the case that we are concerned with, the determination of the concentration, by which the best germination comes to pass, we thus prevent the pollen-masses from altering the concentration of the solution by themselves.

I myself began by cultivating pollen-masses in the following way: I placed a chance number in 10 or 25 c. c. of nutrient solution, and as such was used cane-sugar solutions of different concentrations. The only constant result arrived at through such experiments, is that the pollen-masses are able to germinate in cane-sugar solutions, the concentrations of which are between 5 and 35 per cent. Otherwise the results vary. Now the germination is best at 20 per cent, now at 30, and again at 35 per cent. Sometimes the pollen-tubes are at these concentrations strongly twined, at other times all the tubes of pollen remain inside the pollen-mass as they do at the low concentrations at which germination takes places. On examining the contents of a pollen-mass, which has been germinating for some days in a 5 per cent solution all the grains of pollen will be found to have germinated, but the pollen-tubes to have burst because of some part of the protoplasm having been squeezed out through the end. The matter which CORRY observed in front of the chink of the pollen-mass thus consisted of protoplasm which had been squeezed out. Before leaving these experiments of culture I shall only mention that the pollen-tubes from one pollen-mass in the different solutions are often found to have grown into another, and vice versa.

Further particulars about the conditions of the pollen-mass in culture will be arrived at by cultivating the pollen-masses in very small quantities of liquid e. g. in pendant drops. In this way the pollen-mass may alter the liquid, but this is evidently an alteration, which is of vital import for the development of the tube of pollen.

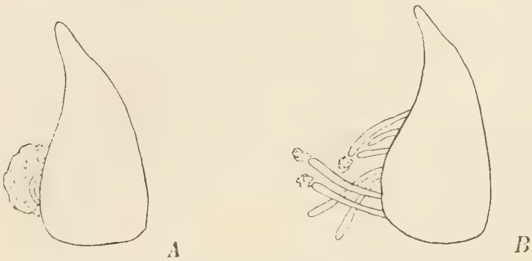


Fig. 4.

*A.* A pollen-mass which has germinated in pendant drop of a 5 per cent cane-sugar solution. × 25. *B.* The germination when 5 pollen-masses have been placed in a pendant drop of a 5 per cent cane-sugar solution. × 25.

It will be found that experiments of culture in pendant drops give constant results. By varying the size of the drop and the number of pollen-masses placed in it the following law may be derived: at low concentrations (5—10 per cent) it takes less liquid in proportion to the pollen-mass to produce a good germination than at higher concentrations (20—60 per cent). While one pollen-mass in a big pendant drop of a 5 per cent cane-sugar solution does not germinate otherwise than in a greater quantity of liquid of the same concentration, the germination gets the better, the more pollen-masses are placed in such a drop (vid. Fig. 4). At higher concentrations in pendant drop, the quantity of liquid may be greater in proportion to the size of the pollen-mass than at 5 per cent, to produce a good germination, and I found that when the proportion between the cubic contents of the liquid and the pollen-mass was of a certain quantity, the germination became far better than I had ever found it in greater quantities of liquid, and the type of germination resembled the one produced in the style. (vid. Fig. 5).

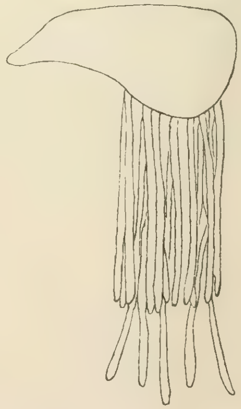

Fig. 5.

Pollen-mass which has germinated in pendant drop of a 30 per cent cane-sugar solution. × 25.

Upon this I tried how one pollen-mass germinates in greater quantities of liquid of different cane-sugar concentrations. Thus it

was proved that the pollen-masses were able to germinate in cane-sugar solutions of different strength (5—35 per cent), while the type of germination was everywhere the same. In all the solutions the majority of the pollen-tubes remained inside the pollen-mass, and the pollen-tubes which succeeded in getting outside the chink, grew back into the pollen-mass once more (vid. Fig. 6).

I shall now endeavour to give an answer to the question, what influence it is which the pollen-mass exercises upon the surrounding liquid, an influence easy to be seen, when small quantities of liquid are used, though less obvious, where the nutrient solution is great in quantity in proportion to the pollen-mass. The question is evidently not of any qualitative alteration of the nutrient solution. A greater quantity of liquid, in which a great number of pollen-masses have been germinating is not better suited to be nutrient solution than is a fresh-preparated one, even as the crushing of pollen-masses in a nutrient solution is of no matter to the use of the latter for experiments in germination. So it is an all but obvious conclusion that we have to do with a quantitative alteration. At low concentrations the pollen-tubes do not get very long before bursting, the less liquid the pollen-mass is placed in, the longer they become, at higher concentrations they get still longer before bursting, and by letting the concentration of the liquid, in which the pollen-mass is placed, rise highly, the bursting of the pollen-tubes may be altogether avoided, though the development of the pollen-tubes will generally be stopped at the same time. If we contemplate these facts and the other conditions of the pollen-mass, starting from the theory of the osmotic pressure, we must conclude that the alteration of the liquid, effected by the pollen-mass, an alteration which makes the pollen-tubes grow, consists in the concentration of the liquid being made to rise, and as the transfer of pollen-masses from one concentration to another in greater quantities of liquid is of no consequence to the growth of the pollen-tubes it is moreover to be concluded that this rise must proceed quite smoothly.

Fig. 6. Pollen-mass which has germinated in 10 ccm. of a 30 per cent cane-sugar solution. The same germination in greater quantities of cane-sugar solutions the concentrations of which are between 10 per cent and 35 per cent. × 25.

Accordingly I will explain the conditions of the pollen-tubes in culture in the following manner. I. The pollen-tubes need in order to grow a particular external stimulus. This stimulus presumably

consists in the liquid, in which the pollen-tubes are growing, altering its concentration quite steadily from a lower to a higher concentration. II. Further, the pollen-tubes are stimulated positive chemotropic by cane sugar. Thus the twinings which often result on the pollen-masses germinating in greater quantities of liquid are explained — in the case of *A. incarnata* I have seen pollen-tubes branch out in the end, — and thus it may also be explained that pollen-tubes in pollen-masses, germinating in greater quantities of liquid, remain inside the pollen-mass, or return to it after having grown outside the chink, as these great pollen-masses are able to produce themselves an alteration of the concentration in their own interior, and, finally, that pollen-tubes from one pollen-mass so readily grow into another pollen-mass.

Pollen-masses are able to germinate at a higher concentration in pendant drop than in greater quantities of liquid. Pollen-masses germinating at such a high concentration in pendant drop, e. g. at 50 per cent, send forth pollen-tubes just as long as at lower concentrations, and the whole type of germination is the same, only the germination proceeds a little slower. It must here be taken for granted that the pollen-mass at first burns the sugar till the concentration in the pendant drop has been reduced to the value at which the germinatinon can begin.

In *Asclepias*, and no doubt in the *Asclepediaceæ* upon the whole, the pollen-tubes may be pulled out of the style, as they come out together with the pollen-mass, from which they issue, on the latter's being taken out. What may be learnt in this way about the pollen-tubes and the fluid of the style corroborates the view, which we have advanced above of the reason for the growth of the pollen-tubes, short pollen-tubes in the style proving to be surrounded by a rather thin liquid, while the longest pollen-tubes, which we are able to take out, are surrounded by a very dense liquid. Moreover the pollen-tubes in the style never twine.

Our experiences of the germination of the pollen-mass of *Asclepias* justify our criticizing the works by Molisch and others, whose task has been to describe the conditions of the germination of the pollen-grains and the growth of the pollen-tubes, for in none of them due allowance has been taken to the fact that the grains of pollen and the pollen-tubes may alter the surrounding liquid. At any rate in the case of two species, viz. *Campanula rotundifolia* and *Linaria vulgaris*, I have succeeded in proving that germination of pollen-grains and growth of pollen-tubes only take place when many grains of pollen are accumulated in the nutrient solution. If the pollen-

grains of these two species are placed separately or few together in pendant drop it is impossible to make them germinate at any concentration; but the pollen-grains of both these species are able to germinate and send forth long pollen-tubes, when a great number are accumulated in a very small pendant drop of a weak cane-sugar solution (e. g. 1 per cent). A fact which in this case also indicates an alteration of the concentration as being the reason of the germination and the growth is that only a percentage of the grains of pollen germinate[1]).

Most probably what has now been asserted in the case of *Asclepias cornuti* and the two above-mentioned species will prove to be true in the case of more plants. This I infer partly from the remarks often met with in the literature that the germination of the grains of pollen is capricious, partly from a remark by ELFVING (7). The latter used for his experiments weak sugar-solutions and remarks about the final fate of the pollen-tubes in culture as follows: In all the cultures the pollen tubes eventually swelled in the end and decayed by bursting.

MOLISCH (4) and others have in the case of the pollen-grains of various plants stated the concentrations of sugar at which the best germination takes place, and the limits within which germination is possible at all. These concentrations prove to be different for the different plants. Perhaps one may draw the conclusion from these figures that the rising of the concentration, required by the different pollen-tubes in order to develop normally is different for the different species. This would agree very well with the results, STRASBURGER (8) arrived at, through his experiments in the way of germinating upon the stigmas of other species of the pollen-grains of different species.

STRASBURGER found that the pollen-grains of many species are able to germinate on the stigmas of other plants and to send shorter or longer pollen-tubes into the styles. This seems to imply that it is not reasonable to take so great qualitative differences for granted between the style-liquids of the different plants, as experiments in culture by MOLISCH (4), LIDFORSS (9) and others implied. Assuming that a rising of the concentration takes place in the style-liquid, different for the styles of different plants, that this rising of the concentration is necessary to the growth of the

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[1]) In Campanula rotundifolia the pollen-tubes often grew from the drop into the air. Such tubes were not attracted by ovules placed in the damp chamber, perhaps because the ovules are here separated from the plant.

pollen-tubes, and that the rising of the concentration which the pollen-tubes of the different plants require is different, the results of Strasburger would receive a simple explanation.

## Results.

I.

1. It has been proved to be likely that the pollen-grains, in the free outer-walls of which the chink of the pollen-mass in *Asclepias cornuti* and *A. incarnata* is formed, are able to become more turgid than the rest of the grains of the pollen-mass. By this the formation of the chink would be explained in the most natural way, as no other reasons for the formation of the chink are to be found.

2. The part of the wall of the pollen-mass, in which the chink is formed absorbs aniline-dyes more quickly and allows these and water to pass more quickly through itself than does the rest of the wall of the pollen-mass.

3. The wall of the pollen-mass assumes in strong sulphuric acid a deep red colour, which disappears in dilute sulphuric acid, in water, and in alkali. In alkali the wall of the pollen-mass gets brown. This colour disappears again in water and in dilute acids.

II.

1. The pollen-mass of *Asclepias cornuti* is able to germinate in cane-sugar solutions of different concentrations, but different according as the quantity of liquid is great or small in proportion to the cubic-contents of the pollen-mass. The pollen-mass germinates best in small quantities of liquid, the concentrations of which are between circa 20 per cent and circa 30 per cent. As the pollen-mass presumably makes the concentration of the small quantity of liquid rise, and as no other alteration of the liquid can be found, the difference of the germination in a great and a small quantity of liquid is most probably due to, that the pollen-tubes in order to grow require that the concentration of the nutrient solution rises steadily and at a certain rate.

2. The conditions of the pollen-tubes placed under different conditions of culture give reason to assume that the pollen-tubes are positive chemotropic to cane-sugar.

3. From out of the style of the plant, pollen-tubes of various lengths may be taken. Short pollen-tubes prove to grow in a thin

liquid, long pollen-tubes in a very dense liquid. This then agrees well with what has been said above of the reason of the growth of the pollen-tubes. In the style the pollen-tubes do not twine.

4. The twinings of the pollen-tubes in culture may be explained by the assumed chemotropy, there being in culture a great chance of unilateral influence upon the pollen-tubes.

5. In *Campanula rotundifolia* and in *Linaria vulgaris* it has also been shown to be probable that the pollen-tubes in order to grow require a gradual rising of the concentration of the nutrient solution.

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# Studies in the Agarics of Denmark*)

## Part IV

**Pholiota. Marasmius. Rhodophyllus.**

By

**Jakob E. Lange.**

With one plate.

## THE GENUS PHOLIOTA.

The great French mycologist Quélet, that ingenious contriver of genera, in his »Flore Mycologique« splits up the old genus *Pholiota* so completely that it is difficult to trace the scattered remnants to their new position. Most of the Friesian section *Humigeni* he lumps (sub nom. *Cyclopus*) with *Hebeloma* and *Naucoria* in a new genus *Hylophila.* Only *P. aurea* (= *Vahlii*) does not go into this genus but is placed in *Lepiota*, next to L. amianthina and others of the section *Granulosi* (sub nom. *Lepiota pyrenæa*). (What Quélet calls P. aurea is P. spectabilis Fr.). — Of the section *Truncigeni* of Fries together with most *Flammulas* and the *fascicularis*-tribe of *Hypholoma* he forms another large genus (*Dryophila*), while *P. mycenoides* is shifted to *Galera.*

As any student of these agarics will see this revolutionary reclassification is in fact a rather natural one, uniting species which really have numerous traits in common, while the old

*) Part I of these Studies (General introduction. The genus Mycena) was published in D. B. A. vol. I no 5 (1914); part II (Amanita, Lepiota, Coprinus) in vol. II no. 3 (1915); part III (Pluteus, Collybia, Inocybe) in vol. II no. 7 (1917). — »Danmarks Agaricaceer« now comprises over 900 watercolour-plates, (Library of the Bot. Museum, Copenhagen) all painted by the author. For further particulars see part I.

Friesian classification is rather artificial — lumping plants of so different a nature as f. inst. *P. præcox*, *P. Vahlii*, *P. squarrosa* and *P. mycenoides* in one genus, merely because their spores are rusty or brown and their stem annulate. My only reason for not following Quélet are the practical difficulties of most innovations. Mycologists are used to regard spore-colour as the leading character of the main divisions of the Agaric family and will find the new paths rather bewildering. Probably a total reclassification of the whole family of Agarics had better be postponed till we have acquired a more detailed and precise knowledge of all the species (including their anatomy), while all we at present know of innumerable species are brief diagnoses made up of a few vague adjectives (partly contradictory in the different textbooks).

But while thus maintaining the genus Pholiota in the Friesian sense I cannot altogether approve the minor points of his classification. Thus he places *P. erebia* in *Eudermini* although its spore-colour decidedly refers it to *Phaeoti*. And the sharp distinction which he tries to establish in the section *Squamosi* between the pallid-gilled and the yellow-gilled species is hardly valid.

The proper delimitation of the genus is no easy task, even when one does not attempt any great deviation from the Friesian classification. Thus f. inst. some of the velate *Galeras* have a veil almost like that found in *Lepiota seminuda* (a membraneous white one which, when the cap expands, forms a row of marginal appendiculate teeth). But I refrain from including them in Pholiota, restricting the genus to embrace the distinctly annulate species. — Some sub-annulate *Cortinarii* may also easily be mistaken for true Pholiotas. In most cases the want of cystidia will serve as an indication of their true nature. Lastly some sub-annulate *Hebelomas* may be mentioned as running into Pholiota (and vice versa). In fact *P. radicosa* and *P. erebia* are by some authors shifted to Hebeloma.

Microscopic characteristics. Two-spored basidia appear to be rare in this genus. The only cases within my range of observation are *P. erebia* and a little Galera-like species which I call *P. teneroides*. — The form and size of the spore is not very variable within the genus; the extremes are $4—5 \times 2^1/_2$ μ (P. flammans) and $12—14 \times 7—8$ (P. caperata). In most cases the epispore is smooth, but in some species it is rough or minutely warty. This is especially the case in species

which deviate from the normal Pholiota-type and branch off into Hebeloma (*P. radicosa*), Cortinarius (*P. caperata*) etc.; but also such a typical Pholiota as *P. spectabilis* has rough spores.

Cystidia are found in most species; but in most cases they are rather trivial: obtusely hairshaped or slightly clubshaped. In a few cases they are vesiculose or inflated-bottleshaped (f. inst. *P. præcox*). Another characteristic type of Cystidium is that found in *P. squarrosa*: obovate-clubshaped, generally tipped with a short cylindric-hairshaped appendix.

The number of Pholiotas figured in »Danmarks Agaricaceer« is comparatively small, only 18, while Fries in »Hymenomycetes Europæi« enumerates 47 (of which 37 seen by himself). The geographical position of Denmark is too northern to give us a fair representation of the South-European tribe *Aegeritini*. And our woods — nearly all of which are under rational cultivation by the forester (old stumps lifted, superannuated and sick trees not allowed to stand etc.) — are a rather poor home for xylophilous fungi.

Still the number of species could undoubtedly be added to. Thus Sev. Petersen (Danske Agaricaceer) records *P. sphaleromorpha* and *phragmatophylla* as well as *P. terrigena* and *P. muricata*. And I myself have seen a specimen (from Sjælland) of a xylophilous Pholiota which probably was *P. aegerita*. If these be added the number of Danish species approaches very much that of the Central-European Pholiotas recorded by Ricken (27). —

# KEY

## TO THE SPECIES OF THE GENUS PHOLIOTA FIGURED IN »DANMARKS AGARICACEER«

**A. Humigenæ** (Fr.). Growing on the ground (vide nos. 9 and 10).

α. Velatæ. Cap with a powdery bloom or set with fibrillous scales (from universal veil).

a. Cap smooth, mealy; outside of ring granulate, radiately sulcate . . . . . . . . . . . . , . . . . . . . . . . . . . . . . 1. *P. Vahlii.*

b. Cap rugose-rivulose, sparsely set with fugacious, fibrillous or cobweb-like scales . . . . . . . . . . . . . . . . . . . . 2. *P. caperata.*

β. Nudæ. Cap smooth.

a. *Phæotæ* (Fr.). Spores dark brown.

1. Basidia 2-spored; cap watery umber or fuscous . . 3. *P. erebia.*

2. Basidia 4-spored; cap whitish or argillaceous.

* Cap almost white, fleshy. Spores $12-13 \times 7^1/_2\,\mu$. 4. *P. dura.*

⁑ Cap pallid argillaceous, subhygrophanous. Spores $9 \times 5\,\mu$. . . . . . . . . . . . . . . . . . . . . . . . . . . 5. *P. præcox.*

b. *Euderminæ* (Fr.). Spores rusty.

1. Basidia 4-spored. Ring radiately sulcate . . . . . 6. *P. togularis.*

2. Basidia 2-spored. Ring almost smooth . . . . . . 7. *P. teneroides.*

(Large, fleshy mushroom with incomplete ring: vide *Phlegmacium claricolor* etc.)

**B. Truncigenæ** (Fr.). Growing on or around stumps or standing trees, on sticks or needles (or attached to Sphagnum).

α. Carnosæ. Cap fleshy, rather compact, not hygrophanous.

a. *Phæotæ.* Spores dull brown.

1. Cap set with cottony, white, deciduous scales . . 8. *P. destruens.*

2. Cap smooth or slightly fibrillose-scaly towards the edge . . . . . . . . . . . . . . . . . . . . . . . . . . . 9. *P. radicosa.*

(Cap smooth, rootless: *P. aegerita,* pag. 9).

b. *Euderminæ.* Spores rusty,

1. Cap more or less viscose or smeary.

* Spores small ($6 \times 3^1/_2\,\mu$); stem with glutinous scales . . . . . . . . . . . . . . . . . . . . . . . . . . 10. *P. adiposa.*

⁑ Spores larger ($8-9 \times 5\,\mu$); stem fibrillous, dry. 11. *P. aurivella.*

2. Cap dry.

* Cap and stem squarrosely scaly.

† Spores $6-8\,\mu$ long. Cap with brown squarrose scales . . . . . . . . . . . . . . . . . . . . . . . 12. *P. squarrosa.*

†† Spores $4-5 \times 2^1/_2\,\mu$. Cap with sulphur-yellow scales . . . . . . . . . . . . . . . . . . . . . . . 13. *P. flammans.*

⁑ Cap with adpressed fibrillous scales. Stem fibrillous . . . . . . . . . . . . . . . . . . . . . . . . 14. *P. spectabilis.*

β. Hygrophanæ (Fr.). Cap but slightly fleshy, hygrophanous smooth.

a. Stem with brown scales below the ring . . . . . . 15. *P. mutabilis.*

b. Stem without brown scales.

1. Growing on wood (twigs, needles).

* Cap 2—5 cm broad; gills rather narrow . 16. *P. marginata.*

⁑ Cap about 2 cm; gills broad . . . . . . . . . . 17. *P. unicolor.*

2. Growing on Sphagnum. Stem very slender. . 18. *P. mycenoides.*

## SYSTEMATIC AND FLORISTIC NOTES.

### A. HUMIGENÆ.

#### α. VELATÆ.

**1. P. Vahlii** (Schum.) (= *P. aurea* Matt.)

Spores 12 × 5 μ, fusiformly ellipsoid. Basidia 4-spored. Cystidia 0. Cells on surface of cap inflated (ovate, subspheric or almost fusiform), light yellow, up to 30 μ long.

Figured specimens: Copenhagen, on the ground (rich soil) in churchyard (Vestre Kirkegård), Oct. 1905 (numerous specimens). — Also found at Holmstrup, in a garden, Oct. 1913 (solitary).

The name *P. aurea* has by several authors (f. inst. Quélet) been applied to *P. spectabilis*, with which this plant has nothing to do. — A very elaborate description is given by Sev. Petersen in »Meddelser fra Foreningen til Svampekundskabens Fremme« (Hæfte 1, 1916). — In my specimens the radiating ridges on the ring (which are well shown in Fries' figure — Icon. selectæ II, 101 —) extend half way down the stem or more. This form is figured by Cooke (loc. cit. tab. 347) sub nom. var. *Herefordensis* Renny. — I do not think there is any real difference between P. Vahlii and P. aurea; but as the latter name has been so much misapplied I deem the former one preferable.

**2. P. caperata** (Pers.) (*Rozites c.* Karsten)

Spores $11^1/_2$—13 × $7^1/_2$—$8^1/_2$ μ, broadly ovate or somewhat lemon-shaped, minutely granulate, somewhat oblique. Basidia generally 4-spored. (1913: Spores 12—14 × 7—$7^3/_4$ μ).

Fig. specimens: Grib skov, wood of Fagus, Sept. 1896. Chiefly in beech-woods, but also met with in mixed (coniferous-foliaceous) woods. Not common.

On account of the rudimentary universal veil Karsten has placed this species in a new genus, *Rozites*, intended to form a parallel to *Amanita*. Fries in his earlier works referred it to *Cortinarius* (*Phlegmacium*).

β. NUDÆ.

3. **P. erebia** Fr.

Spores 10—13 × 5—6 μ, ellipsoid. Basidia 2-spored, about 7 μ broad. Cystidia cylindric-clubshaped, about 10—12 μ broad (1909).

Fig. specimens: Trolleborg, wood of Fagus, gregarious on moist ground. Not rare.

Fries (loc. cit.) figures this species sub nom. *Armillaria denigrata*. Ricken (Die Blätterpilze) besides P. erebia (in the supplementary notes pag. 460) describes a plant which he calls *P. ombrophila* Fr. But the two descriptions are almost identical. Fries' figure of *P. ombrophila* var. *brunneola* is not unlike a pale P. erebia; but according to his descriptions it belongs to *Eudermini*, close to *P. togularis*. However as he also — erroneously — places P. erebia in Eudermini, it is not improbable that his figure represents a form of P. erebia.

4. **P. dura** Quélet ((Bolt.) Fr.?)

Spores 12—13 × $7^1/_2$ μ, ovate-ellipsoid. Edge of gills rather sparsely set with broad, obtuse, cylindric-sackshaped, 14—16 μ broad cystidia.

Fig. specimens: Hjallese, border of road, in grass, July 1897. Rather common on roadsides and in cultivated fields.

Not clearly distinguished by several authors from *P. præcox*. It differs from P. p. macroscopically by its cream-white, rather fleshy and absolutely non-hygrophanous cap (while in P. p. the cap is more or less argillaceous or horn-brownish and subhygrophanous) and microscopically by the larger spores etc. — Schroeter (loc. cit.) describes it very well sub nom. *P. candicans* (Schaeff.); but the dimensions of the spores which he gives are rather those of *P. præcox*. Fries (Hym. Europæi) describes it as having a »fulvous« or »alutaceo-fuscescent« cap. And probably what he calls P. dura is really but an open-air form of P. præcox. — I follow Quélet, Ricken and others in attaching the name P. dura to the white species.

4 a. **P. dura** var. (*P. vermiflua* Peck)

Spores as in type. Cystidia ovate or balloon-shaped, about 18 μ broad.

Fig. specimens: Hunderup, on naked ground amongst garden-shrubs, July 1915.

A large and strongly areolate-rimose form very much like the one (var. *xanthophylla*) figured by Bresadola (loc. cit. fig. 159), but the gills are not yellowish.

5. **P. præcox** (Pers.)

Spores 9—10 × 5—$5^1/_2$ μ, ovate-ellipsoid. Cystidia rather sparse (on edge and faces of gill), up to 20 μ broad, inflated flask-shaped, obtuse.

Fig. specimens: Hunderup, wood of Fagus, on the ground, June 1899. Rather common, like the preceding species, from midsummer till harvest-time.

5 a. **P. præcox** var **paludosa** J. E. L.

Spores etc. as in type.

Fig. specimens: Dalumgård, marshy meadow, June 1901, and Lindvedgård (similar locality), June 1907.

This little slender form has the stature of a Naucoria. The cap is only $1^1/_2$—3 cm broad, the stem very slender, somewhat wavy, 5—6 cm × 2—3 mm. When fresh it is minutely striate around the edge.

5 b. **P. præcox** var. **cutefracta** J. E. L.

Spores etc. as in type.

Fig. specimens: 1) Hesselager, border of road, Oct. 1906. 2) Horsens, amongst grass in outskirts of wood of Fagus near the fjord.

More compact, not hygrophanous, at last areolate-rimose. This probably is what Fries called P. dura (vide supr.).

6. **P. togularis** (Bull.)

Spores $7^1/_2$—9 × $4^3/_4$—5. Basidia 4-spored. Cystidia hairshaped, protruding portion 30—35 μ long, apex obtuse, slightly swelled, up to 7 μ broad.

Fig. specimens: 1) Hjallese, on old lawn, April 1898. 2) Same garden, on cultivated ground, Maj 1903. Common in similar localities.

The first figure represents the paler form, the second a larger and darker brownish (subferrugineous) form, which somewhat approaches the description of P. ombrophila Fr.

(Fries in his earlier works applied the name *P. Arrhenii* to this species, using the name *P. togularis* for the plant which in »Hymenomycetes Eur.« he calls *P. ombrophila.*)

6 a. **P. togularis** var. **filaris** Fr. (Icon. sel. tab. 104).

Spores $7^1/_3$ × $4^1/_4$ μ. Cystidia hairshaped.

Fig, specimens: Hjallese, copsewood, on the ground, 1) Oct. 1895 and 2) Sept. 1897.

Smaller (cap 1—1,6 cm) and more slender (stem 2 mm), cap somewhat striate. — Like the typical P. t. it is characterized by the radiately sulcate ring. Ricken (loc. cit.) applies the name *P. blattaria* Fr. to this species; but the Friesian species has a smooth ring (vide his »Monographia Hymenomycetum Sueciae«, vol. I pag. 308).

7. **P. teneroides** nov. sp.

Spores 11—12 × 5—$5^1/_2$ μ ellipsoid. Basidia 2-spored. Cystidia cylindric-flaskshaped, obtuse, about 12 μ broad.

Fig. specimens; Erholm, moist ground in wood of Fagus, amongst dead sticks and twigs of Picea, Sept 1913. (Also at Hjallese, moist copsewood, on the ground, Sept. and Oct. 1915).

*Pileo 1,5—1,8 cm, convexo-campanulato, hygrophano, exstrio, ochraceo-ferrugineo (sicco: ochraceo-lutescente, rugoso). Stipite elato, tenui (6.5 cm × 2 mm), subtiliter striato, lutescente, e basi fuscescente, intus ferrugineo, glabro (primitus leviter albo-plumuloso). Annulo angusto, plano, læviusculo, membranaceo. Lamellis latis, primitus pallide ochraceis, dein ferrugineis, subdistantibus (subliberis)- Sporæ et cystidia ut supr.*

It is not improbable that this species is identical with *P. togularis* (Bull.) sensu Ricken (loc. cit. pag. 199) which again he considers almost like *Galera ovalis* Fr.; but neither of the Friesian descriptions appear to me to confirm this opinion. From Galera tener (with some forms of which it has a habitual likeness) it can easily be distinguished, not only by the annulate stem but also by the totally different cystidia.

## B. TRUNCIGENÆ.

### α. CARNOSÆ.

8. **P. destruens** Brond.

Spores $7^1/_2$—$8^1/_2 \times 5$ μ, oval, sub micr. pale brown. Basidia 4-spored. Cystidia hairshaped, obtuse, about 5 μ broad.

Fig. specimens: Flødstrup, on stump and dead trunk of Populus canadensis, Sept. 1899. Not uncommon, always on Poplar. The fruitbodies always spring from the central part (the pith-region) of the stump, while in most other xylophilous fungi they are chiefly to be found in the peripherial region. — *Bresadola* (loc. cit.) and others consider *P. heteroclita* Fr. identic. And as Fries has not seen P. destruens, this is not unlikely. However I have never met P. destruens on Betula, on which tree P. heteroclita is said to grow profusely in Northern Europe.

9. **P. radicosa** (Bull.)

Spores $7^1/_2$—$9^1/_2 \times 5$—$5^1/_2$ μ, ovate-ellipsoid, very minutely asperulate. Basidia 4-spored. Cystidia hairshaped-clubshaped, up to 40 μ long and 8 μ broad (in some cases broader, up to 12 μ).

Fig. specimens: Ravnholt, in wood of Fagus and Quercus, Oct. 1897. — Not uncommon, but generally solitary.

The cap, which Fries describes as »laevi, glabro«, is often more or less squamose-fibrillose towards the edge (from velum). The spores are very much like those of most Hebelomas (not coarsely warty as shown in Ricken's figure (loc. cit. tab. 33).

A form, *P. radicosa minor* (not figured) was found by me in wood of Betula (Trolleborg 1897). The cap was only $3^1/_2$ cm broad, the stem almost rootless. It grew in numbers on the ground.

[*P. aegerita* Brond. I have seen a specimen of a fungus (found in northern Sjælland growing on an old board) which probably was a true P. ae. The spores were $9 \times 5$ μ, sub micr. transparent, light brownish-yellow. The cap looked like a large P. præcox. This somewhat dubious record is the first for Denmark, I believe, of a representative of this South-European tribe.]

10. **P. adiposa** Fr.

Spores $5^1/_2-6^2/_3 \times 3^1/_2-3^3/_4$ μ, oval, smooth, sub micr. pale brownish-yellow, Basidia 4-spored.

Fig. specimens: Hesbjerg, clustered at the base of stumps of Fagus. — Rather common, generally fasciculate on (and occasionally in the vicinity of) stumps of Fagus.

Although this agaric is one of the most characteristic species (and rather common) authors disagree very much about it. Thus Quélet (and Saccardo) says the spores are about 9 μ long. And Fries himself (in Hymenomyc. Europæi) describes it as »intus albus«, while in fact the flesh of the cap is pale yellowish, that of the stem yellow.

11. **P. aurivella** (Batsch)

Spores $8-9 \times 5$ μ (or $7^1/_2-9 \times 4^3/_4-5^1/_2$).

Fig. specimens: »Fjellebro« near Egeskov, fasciculate on dead Alnus (?) (several meter from the ground), Oct. 1900. (Also found at »Fruens Bøge«, on Fagus, Oct. 1914 and at Krabbesholm (on Juglans), Oct. 1918, in both cases nestling in small clusters in decaying knotholes of living trees).

Very well characterized by the triangular, broad, adpressed, dark bay-brown scales on the yellow or subferrugineous cap. Fries describes the cap as »subviscido«. But whenever I have seen it I have found the surface of the cap strongly slimy. I have never met with this species on stumps or at the foot of trees.

11 a. **P. auriv.** var.

Spores $9 \times 5-5^1/_2$ μ, oval-ovate, sub micr. yellowish-brown (Spore-powder dark cinnamon). Cystidia hairshaped, short.

Fig. specimens: Fruens Bøge, solitary on living Fagus, Oct. 1912 (and 1917) and on another beech Oct. 1914.

Differing from the type by the pale yellow (central part somewhat ferrugineous) cap and the stem which up to the ringlike zone is densely clad with recurved squarrose scales which at first (like the stem) are whitish, but soon turn brownish-rusty (from base upward). — Is this *P. cerifera* Karst. (Mycologia Fennica III p. 169)?

12. **P. squarrosa** (Müll.)

Spores $7-8 \times 4$ μ, ellipsoid-oval. I have also met with specimens of this species (on Fraxinus) with somewhat smaller spores

($6\frac{1}{2} \times 3\frac{1}{4}$ μ) and obovate-clubshaped cystidia (8—10 μ broad) with or without a short hairlike appendix.

Fig. specimens: Hjallese, fasciculate on foot of Quercus, Oct. 1895. — Rather common, on various trees (Malus, Robinia Picea etc.).

13. **P. flammans** Fr.

Spores 4—5 × $5\frac{1}{2}$ μ. ellipsoid. Cystidia crowded, rather obtuse, cylindric-bottleshaped, total length about 30 μ.

Fig. specimens: Kumpedal near Kellerup (Jyll.), on stump of Picea, Sept. 1897. Rather rare.

14. **P. spectabilis** Fr.

Spores 8—10 × 5—$5\frac{1}{2}$ μ, ovate-ellipsoid, minutely granulate. Cystidia crowded, obtuse, hairshaped, apex slightly swelled. Basidia 4-spored.

Fig. specimens: Dyrehaven near Copenhagen, on foot of living Crataegus, Oct. 1897. Not uncommon on stumps and at the base of old trees (Ulmus, Fagus, Quercus etc.).

The plant varies very much in size (from 4 cm to 23 cm broad) and surface of cap (from almost smooth, slightly fibrillose to almost squarrose).

β. HYGROPHANÆ.

15. **P. mutabilis** (Schaeff.)

Spores 6—7 × 4—5 μ, ovate-ellipsoid. Cystidia crowded, short, hairshaped, apex slightly swelled and rounded, free portion about 12—14 μ long.

Fig. specimens: Hunderup, on stump, densely fasciculate, June 1901. Common, exclusively on foliaceous trees, from spring till late in the autumn.

16. **P. marginata** (Batsch)

Spores $8\frac{1}{2} \times 5\frac{1}{2}$ μ, ovate-ellipsoid (1896) or $7\frac{1}{3}$—9 × 5—$5\frac{1}{2}$ μ. Cystidia hairshaped, apex obtuse, base somewhat inflated (1910).

Fig. specimens: Hjallese, on stump of Picea, fasciculate, Oct. 1896. — Typical form rather rare, generally confined to coniferous wood; but I have also (1910) seen it growing on stump of foliaceous tree (Fagus?) — a form with very narrow and crowded gills.

17. **P. unicolor** (Vahl)

Spores A: $7\frac{1}{2}$—9 × $4\frac{1}{2}$—5 μ, ovate or ovate-ellipsoid. B: 9—10× 5—$5\frac{1}{2}$ μ. Cystidia obtuse, hairshaped, base somewhat inflated (6—9 μ), free portion 40—50 μ long.

Fig. specimens: A. Hjallese, on stump of Salix capræa, solitary Oct. 1898. B. Hjallese, on rotten stump of Picea (a number of specimens) Oct. 1898.

The form B. had darker (almost ferrugineous-fuscous) stem and broader, more triangular gills than A. — Rather rare; but on fallen sticks of Picea an intermediate form between nos. 16 and 17 is not rarely met with. It seems to me that the specific value of P. unicolor is rather dubious; it is hardly more than a small and dwarfy form of P. marginata.

18. **P. mycenoides** Fr. (?)

Spores $10-11 \times 6^1/_2$ μ, ovate (1898) or $9-10 \times 6$ μ, somewhat lemonshaped (1914—17). Cystidia obtuse, cylindric-hairshaped, base slightly swelled, total length about 30 μ, base 9 μ, apex 5—6 μ. Basidia 4-spored.

Fig. specimens: Holstenshus, growing on Sphagnum in a bog, July 1898 (and Sept. 1909, July 1914 and 17).

I add a brief description of this little Galera-like fungus: Cap $1^1/_2$—2 cm, conic-convex with small umbo, pellucido-striate, at first gilvo-ochraceous, then somewhat ferrugineous, strongly hygrophanous. Stem slender (7—8 cm × 2 mm), paler than the cap, with a little cottony ring that soon disappears, above the ring slightly mealy and just below the ring with some few scattered white, fugacious squamules. Gills rather crowded, broadly adnate with a slightly decurrent tooth, ochraceous.

On account of its fugacious ring I refer this species to Pholiota; but it is very closely allied to the hypnophile Galeras and Tubarias. *Pholiota muscigena* Quélet appears to me (to judge from his description) very nearly the same plant; and *Tubaria paludosa* Fr. forma *stygia* (Icones selecta pag. 28) chiefly differs in the even, not pellucido-striate cap. — The typical P. mycenoides (of Fries) differs from my plant in having a »membranaceous, entire and persistent« ring (Fries: Monographia I pag. 321).

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For figures of spores and cystidia of the several species vide the plate.

# THE GENUS MARASMIUS.

The synonymy of the *Marasmii* appears to me less entangled than that of most other genera of the Agarics. Presumably this is chiefly due to the fact that these fungi can be preserved. While dried specimens of most other agarics are hardly recognizable, type-specimens of a Marasmius can be kept for examination in a herbarium in a comparatively good condition. And while the description of f. inst. a *Coprinus* or a *Cortinarius* to be of any value must almost be written down on the spot, at the right moment, a Marasmius requires no hurried work: it can be correctly described in the laboratory days or weeks after the foray. — Still a good deal of ambiguity exists, and probably the number of names is considerably larger than the number of species. Thus in a recent work (F. Bataille: Flore monographique des Marasmes d'Europe) the author describes 96 species (while Fries in Hymenomycetes Eur. only has about 60). But of these Bataille has only seen 24 (one fourth), that is to say about the same number and almost the same species as Fries himself knew and which are also on record from Denmark in recent years. This suggests to me that at least some of the other 72 species — when properly compared and critically examined — will be found to be mere names.

But while well worked up by the earlier mycologists, the classification of the genus Marasmius has not profited much by modern methods of investigation. The introduction of the microscope in mycological work has not considerably altered our conception of the different species. If you cannot distinguish two nearly allied species by means of a pocket-lens, the microscope in most cases is not likely to help you. Thus the spores, which in most genera are of the highest value as a specific character (and may serve even to characterize sections or subgenera), are in Marasmius almost uniform. Only a single European species (which has not been found in Northern Europe)

*M. epodius* Bres. has extraordinarily long, almost needleshaped spores. In general the spores are sub-ellipsoid, smooth, attenuated of the base. In most cases they are pipshaped, but occasionally they are more narrow, fusiform or almost club-shaped. Nor do they vary much in size. The extremes in the species observed by me are $11 \times 7$ μ (*M. alliaceus*), $11 \times 4^3/_4$ μ (*M. recubans*), $6 \times 3^1/_2$ μ (*M. perforans*) *).

The genus appears to comprise no 2-spored species. — Cystidia in most species are wanting or inconspicuous; but some few species have characteristic setulæ (borstlike cystidia?) on the gills or the stem. Another type of cystidia (which is very commonly met with in Mycena) is found in some few of the smaller Marasmii on the edge of the gills. These cystidia are obovate with small wartlike excrescences. Finally in a single species (*M. cohærens*) the surface of the cap is made up of cells crowned with a number of small coloured setula which give to the cap a somewhat velvety bloom.

Classification. I do not think the systematic arrangement of the species within the genus Marasmius has been very much improved since the time of Fries. Probably a really satisfactory classification cannot be attained as long as we know so very little about the innumerable tropical species. (Although our knowledge of the mycological flora of the Tropics is as yet very fragmentary the number of Marasmii recorded from these parts is very large. As early as in the eighties of last century Saccardo (Sylloge Fung. vol. V) enumerates about 200). *Marasmius* (and the same holds true of *Lentinus*) evidently has its centre of distribution in the tropical countries, the European species being only as it were the sentinels of an army — similar in this respect to the *Ericas* of Northern Europe as compared with those of the Mediterranean flora.

Some few of the Friesian species are now generally regarded as mere forms or varieties. Thus *M. urens* and *M. peronatus* are by most authors treated as synonymous, and so are *M. Wynnei*, *M. globularis* and others. *M. epichloë* is hardly anything but *Collybia stipitaria*, and *M. calopus* too close to *M. scorodonius* to be considered a distinct species. Even *M. argyropus* I feel

*) Massee (European Fungus Flora) mentions several species with gigantic or very minute spores. Thus for M. prasiosmus he has $14—16 \times 7$ μ, for M. alliaceus $14—16 \times 8$ μ, for M. fuscopurpureus $4 \times 3$ μ, for M. graminum $4 \times 3$ μ etc. But to my mind these observations are not altogether reliable.

inclined (like Schroeter) to regard as identical with *Collybia confluens* (see below). Such alterations will reduce the number of Marasmii a little, but on the other hand *Mycena cohærens* evidently is a true Marasmius, very close to *M. lupuletorum*.

Several post-Friesian authors have tried materially to alter his classification. Thus KARSTEN (loc. cit.) splits the genus in two, making of the Friesian section *Mycena* a new genus *Androsaceus* (Patouillard) and uniting his section *Collybia* (sub nom. *Eu-Marasmius*) with the genuine *Collybias* in a genus *Marasmius* (sens. nov.). Evidently a good deal can be said in favour of this rearrangement. Still such species as M. globularis, M. lupuletorum (Bresad.) and M. scorodonius (of the *Eu-Marasmii*) differ considerably from the Collybia-type and link the Collybia-like species to the *Androsacei*, f. inst. M. cohærens, M. alliaceus and others.

RICKEN, who maintains the Friesian genus, alters the classification by dividing the section Collybia in two instead of the original three. This is done by splitting up the second lot (*Tergini*) and dividing its constituents between the first *(Scortei)* and the third *(Calopodes)*. I consider this a decided improvement. In fact the group Tergini is not very well defined by Fries. Thus while he places *M. globularis* in group A, he puts *M. Wynnei* (which is probably identical) in group B. — But like QUÉLET I think it better to transfer M. alliaceus and its allies (the Friesian group *Chordales*) from sect. II *(Mycena)* to sect. I *(Collybia)*; and consequently I also adopt the Quéletian names for the two main sections, viz: *Radicosi* and *Insititii*. (The annulate, resupinate and sessile marasmioid species I leave entirely out of consideration, as I have never seen any of them.)

The most ambiguous species to fit into any system are *M. foetidus*, *M. ramealis* and their allies. FRIES places them in *Calopodes*, together with M. scorodonius etc. with which they have very little in common; QUÉLET on the other hand transfers them to *Insititii*. I am inclined to think they cannot be properly classified without working up simultaneously the whole field of allied species from the Tropics. — *M. scorodonius* too stands rather isolated, without any natural affinity to other species here mentioned. Like Ricken I place it next to M. lupuletorum etc.

The minor points of my classification can be seen in the Key and will require no particular explanation.

# KEY

## TO THE SPECIES OF THE GENUS MARASMIUS FIGURED IN »DANMARKS AGARICACEER«.

**A. Radicosi** (Quélet). Large or medium-sized species (cap $1^1/_2$ cm or more): Stem somewhat rooting or attached to the substratum by means of mycelium. Generally growing on the ground. (NB.: nos. 9—11.)

α. Scortei (Fr. ext.). Stem tough, but not cartilagineous or horny, generally becoming hollow with age, but not distinctly fistulose from the beginning, more or less fibrillose.

a. Taste pungent. . . . . . . . . . . . . . . . . . . . . . . . . . . . 1. *M. urens.*

b. Taste fade

1. Base of stem strigose.

* Cap wrinkled, but not pellucido-striate, becoming dark purplish-brown. Base of stem curved, attached to dead foliage . . . . . . . . . . . . . . . . . 2. *M. fuscopurpureus.*

⁑ Cap pellucido-striate. Stem straightly rooting amongst dead needles (of Pinus). . . . . . . . . . . . . . . . . 3. *M. putillus.*

2. Base not strigose.

* Gills distant. Growing on the ground (parasitic on grass-roots) forming »fairy-rings« . . . . . . . . . 4. *M. Oreades.*

⁑ Gills very crowded (vide *Collybia confluens*).

β. Cartilaginei. Stem cartilagineous or almost horny, distinctly fistulose, polished or velvety-pruinate, generally becoming bay-brown or sepia from base upward.

a. Without smell.

1. Cap, gills and apex of stem at first milkwhite. 5. *M. globularis.*

2. Cap brownish or ochraceous-pallid. Gills wood-coloured (pallid) or yellow.

* Gills pallid, almost free.

† Gills (especially on the edge) set with brown setulæ or borsts. Stem polished. . . . . . . . . . . . 6. *M. cohærens.*

†† Gills without borsts. Stem minutely velvety-pruinose . . . . . . . . . . . . . . . . . . . . . . . 7. *M. lupuletorum.*

⁑ Gills decurrent, yellow: *M. cauticinalis.*

b. Smelling of garlic.

1. Stem polished, glabrous, fulvous-bay. . . . . . 8. *M. scorodonius.*

2. Stem powdery or velvety.

* Stem without root, attached to dead foliage, base bay-brown, velvety . . . . . . . . . . . . . . . . 9. *M. prasiosmus.*

⁑ Stem rooting, blackish or fuscous, velvety-pruinose. . . . . . . . . . . . . . . . . . . . . . . . . . . . 10. *M. alliaceus.*

**B. Rameali.** Small or dwarfy (less than 3 cm high). Stem insititious, tough (but not horny) minutely flocculose or velvety. Growing on twigs (or on dead stems of herbaceous plants).

α. Cap 2—3 cm. Stem blackish, velvety. Stinking. . . . 11. *M. foetidus.*

β. Cap about 1 cm. Stem pale or brownish. Inodorous.

a. Stem brown, setulose Cap whitish with minute brown fibrillose adpressed scales (vide *Collybia stipitaria*).

b. Stem pale, slightly downy or flocculose.

1. Cap pallid, slightly incarnate . . . . . . . . . . . 12. *M. ramealis.*

2. Cap pure white (*M. candidus*).

**C. Insititii** (Quélet). Stem insititious, borst- or hairlike, blackish or umber.

α. Rotulæ (Fr. ex parte). Gills forming a short tube around the stem, like the nave of a wheel.

a. Cap milk-white, 0,6—1,5 cm . . . . . . . . . . . . . . . 13. *M. Rotula.*

b. Cap tile-red or pallid woodcolour.

1. Cap wood-coloured, pallid.

* Stem about 3 cm. Growing on dead foliage. Spores $< 10\ \mu$ long. Gills 8—12 . . . . . . . . . . . . 14. *M. Bulliardi.*

⁑ Stem capillary. Growing on dead grass. Spores $> 10\ \mu$. Gills 6—7. . . . . . . . . . . . . . . . . 15. *M. limosus.*

1. Cap more or less tinged tile-red . . . . . . . . 16. *M. graminum.*

β. Perforantes. Gills not forming a tube or nave around the stem.

a. Stem glabrous . . . . . . . . . . . . . . . . . . . . . . 17. *M. androsaceus.*

b. Stem velvety, hairy or downy.

1. Gills rather broad.

* Foetid. Cap about 1 cm, pale with a rufous tinge. Stem black, velvety . . . . . . . . . . . . . . . . 18. *M. perforans.*

⁑ Inodorous. Cap 3—4 mm, semiglobate, milk-white. Stem capillary, umber, slightly hairy . . . . . 19. *M. recubans.*

2. Gills fold-like or reduced to wrinkles on lower surface of cap. Cap milk-white, about 1 cm, flat. . . 20. *M. epiphyllus.*

## SYSTEMATIC AND FLORISTIC NOTES.

### A. **RADICOSI** (QUÉLET).

#### α. SCORTEI (FR. ext.).

1. **M. urens** (Bull.) (*M. peronatus* Bolt.)

Spores $9 \times 3^3/_4$ μ, pipshaped-lanceolate. Cystidia crowded, short, cylindric.

Fig. specimens: Hjallese, in wood of Fagus, Aug. 1896. Common in woods amongst foliage (also in coniferous woods).

This species varies a good deal in colour (from pallid to dingy rufous wood-colour. The base of the stem is more or less peronate. But like Schroeter and other authors I can see no sufficient reason for distinguishing two species (M. urens and M. peronatus). — SACCARDO gives for M. urens the spore-measure $3—4 \times 2^1/_2—3$ μ, for peronatus $6—8 \times 3—5$ μ; MASSEE has $8 \times 4$ μ and $10 \times 6—7$ μ respectively. But I have never observed either the very small or the very large spores in any specimens.

2. **M. fuscopurpureus** (Pers.)

Spores $6^1/_2—8 \times 3—3^1/_2$, pipshaped-lanceolate. Basidia with very long sterigms (8 μ).

Fig. specimens: Hjallese, wood of Fagus, Oct. 1895 and 1909 (young). FRIES places this species in *Tergini*, but its natural position is next to M. urens He describes the strigose coating at the base as »rubiginous«; but it is generally dingy ochraceous-pallid. When young the whole plant is much lighter in colour (pale gilvous-ochraceous), the edge minutely striate. This to my mind is probably *M. terginus* Fr.

3. **M. putillus** Fr.

Spores $9 \times 3^3/_4$ μ, pipshaped-lanceolate.

Fig. specimens: Håre Bjerge, rather numerous, rooting in a deep layer of Pinus montana-needles, Oct. 1906. Also found at Årup, Oct. 1911, in wood of Pinus silvestris.

4. **M. Oreades** (Bolt.)

Spores $9^1/_2—10^1/_2 \times 5^1/_2—6$ μ, broadly pipshaped.

Fig. specimens: Fruens Bøge, old grassfield, border of road,

Aug. 1904. — Very common, generally forming »fairy-rings« by its parasitic growth.

[*M. argyropus* (Pers.) I consider synonymous with *Collybia confluens* (vide part III of these Studies).]

## β. CARTILAGINEI.

5. **M. globularis** Fr.

Spores 6—7 × 4 μ, broadly pipshaped.

Fig. specimens: Hjallese, wood of Fagus, Oct. 1895, subfasciculate. Rather common in woods of Fagus (and Picea). —

Like Ricken I see no real difference between this species and *M. Wynnei* Berk. and *M. fuscescens* Schroet.

6. **M. cohærens** (Pers.) (*M. erythropus* Schroeter.)

Spores 9—$9^1/_2$ × 5 μ, obovate-pipshaped, base somewhat oblique. The face and especially the edge of the gills is generally (but not always) set with long, brown, acute, awlshaped setulæ (about 50 μ × 7—8 μ). The surface of the cap is formed of basidiiform, hyaline cells the top of which are crowned with numerous small brown borsts. Among these cells are isolated setulæ like those on the gills.

Fig. specimens: Hjallese, copsewood, Sept. 1897 and 1898. Not uncommon. Fries places this species in *Mycena*. I consider *Mycena balanina* Berk. identic. Ricken and others give *M. ceratopus* Pers. as a synonym.

7. **M. lupuletorum** (Weinm.) Bres. (nec Fries).

Spores 9 × $4^1/_2$ μ pipshaped. Cystidia on edge obovate, 20×11 μ. Setulæ on stem brown, acute, 60 × 6 μ.

Fig. specimens: Ålykkeskov near Odense, on the ground amongst dead foliage, twigs etc., Aug. 1918. Rather common.

Differs from the preceding species by the cap not being pruinate and generally of a paler colour, and by the stem which is everywhere minutely powdery-flocculose (from the setulæ). — It is rather peculiar that these brown setulæ which in the one are found on the cap and gills, but not on the stem, are in the other wanting on the cap and gills but present on the stem. —

Bresadola (loc. cit. tab. 130) describes and figures this species with a short incurved stem what I think rather abnormal. Rickens description is more to the point. Fries' (*Collybia*) *lupuletorum* (Weinm.) is totally different; but some authors think his *M. erythropus* is a synonym to M. lupuletorum as here understood (not to no: 6), although he describes its stem as glabrous.

[The characteristic little species *M. cauticinalis* (With.), which is not uncommon in the Scandinavian pinewoods, is probably also to be met with in similar localities in Denmark. It differs from all the other species by the clear yellow, decurrent gills.]

8. **M. scorodonius** Fr. (*M. alliatus* Schaeff.)

Spores 7—8 × $3^1/_2$—4 μ, pipshaped.

Fig. specimens: Arup, on tufts of grass in plantation, Sept. 1899. — Common, chiefly on grass but also on twigs of Calluna, Picea etc. (especially on sandy land).

9. **M. prasiosmus** Fr.

Spores 9 × 5 μ pipshaped. (Another find: 8 × $4^1/_2$—5 μ).

Fig. specimens: Hjallese, in wood, attached to dead leaves of Quercus, Oct. 1985. Rather rare, chiefly on oak-leaves but also found in wood of Fagus.

My plant is almost intermediate between the descriptions of *M. prasiosmus* and *M. porreus* (Pers.). On account of the persistent smell, the rather crowded and thin gills etc. I refer it to M. prasiosmus. The stem is minutely powdery-pubescent above and densely clad with a bay-brown velvety coating below, which dilates on the leaf on which it grows. According to MASSEE the spores of M. prasiosmus are 14—15 × 7 μ (those of M. porreus subglobose, 4 μ in diameter). According to RICKEN they are 7 × 4 μ, while BATAILLE has 8—11 × 4—5 μ.

10. **M. alliaceus** (Jacq.)

Spores 10—$11^1/_2$ × $6^1/_2$—7 μ, ovate. Cystidia on edge crowded, inflated-cylindric or subfusiform, about 11 μ broad. The coating of the stem is made up of hyaline, cylindric, obtuse, 6—9 μ broad hairs.

Fig. specimens: Grib skov, (wood of Fagus), Sept. 1896. Common. The root springs from buried sticks or branches (always of Fagus).

10a. **M. alliaceus** var. **subtilis** (nov. var.)

Spores 10 × $6^1/_2$ μ, broadly ellipsoid-ovate. Cystidia obtuse, cylindric-hairshaped or slightly ventricose, 6—8 μ broad. Hairs on stem scattered, short, erect.

Fig. specimens: Ry, on the ground under old Fagus, in wood, Aug. 1902. (Also found at »Fruens Bøge« Aug. 1916, similar locality.)

Cap 3—$4^1/_3$ mm, convex, pellucido-striate, pallid fuscous. Stem setaceous, rooting, 3—4 cm high, 0,4 mm broad, fuscous, apex whitish, pruinate. Gills free, distant, broad, ventricose, dingy whitish. — Although this little tiny plant at first sight not at all reminds you of M. alliaceus I do not think it deserves specific rank.

## B. RAMEALI.

11. **M. foetidus** (Sow.)

Spores $8^1/_2$—10 × $3^3/_4$—4 μ, lanceolate-ellipsoid, somewhat flattened on one side.

Fig. specimens: Hjallese, on sticks and stumps of Corylus, Oct. 1895. (Also found at Revninge, on Corylus).

[Probably the pretty little *Collybia stipitaria* (Studies III pag. 19) has its proper place here. *Marasmius epichloë*, *M. caulicinalis* (Bull.) and *M. scabellus* (Alb. at Schw.) to my mind are all synonymous.]

12. **M. ramealis** (Bull.)

Spores 8—9 × $2^1/_2$ (or $8^1/_2$ × $3^1/_4$) μ, lanceolate-ellipsoid. Cystidia sackshaped with short hairlike excrescences, small.

Fig. specimens: Hjallese, on twigs of Corylus, gregarious, Nov. 1896. Very common on twigs, sticks and dead herbaceous stems, often densely crowded. — Cooke erroneously figures and describes the spores as only 4 × 2 μ (loc. cit. tab. 1127 B.).

[*M. amadelphus* (Bull.). On twigs of Cratægus I have met a form with more saturately coloured (dingy incarnate-fulvous) cap which was very much like the plant figured by Bulliard (550 III) as M. a. But as it did not differ in any other way from M. ramealis, I do not regard it as a distinct species. The M. amadelphus described and figured by Bresadola (loc. cit. tab. 130 II) is also very much like mine, but has somewhat larger spores. (10—12 μ).]

[*M. candidus* (Bolt.). In moist and shady places, amongst grass (on dead tufts of grass, small twigs etc.) a little slender form of M. ramealis is occasionally met with. The cap soon becomes snow-white, the stem is almost glabrous, whitish. This probably is *M. candidus* (Bolt.), but I am inclined to regard it as an etiolated form of M. ramealis. The spores are somewhat shorter ($7^1/_2$ × $3^1/_4$ μ), while Quélet has 16 μ and Bataille 12—14 × 5—6 μ. But on Cooke's figure (loc. cit. tab. 1127 C), said to be »after Bolton«, they are much smaller.]

## C. INSITITII (QUÉLET)

### α. ROTULÆ (Fr. ex parte).

13. **M. Rotula** (Scop.)

Spores 8—9 × $3^1/_2$—$4^1/_2$ μ, pipshaped. Cystidia few in number, inflated, apex somewhat granulate-warty.

Fig. specimens: Allerup and Hjallese, on dead half-buried twigs and thereabout, in copsewood, Oct. 1895. — Common.

14. **M. Bulliardi** Quélet.

Spores $8^1/_2$—10 × $4^1/_4$—$4^1/_2$ μ, pipshaped. Cystidia as in no: 13.

Fig. specimens: Ålykkeskov near Odense, on dead foliage (under Fraxinus etc.) on boggy ground, Sept. 1904. Rather rare. The somewhat smaller and pale wood-coloured cap distinguishes this species from no: 13. But the small branchlets with abor-

tive heads are only developed in damp places. When they are wanting you have *M. Rotula* var. *phyllophila* Schroeter which is rather common in our woods (on leaves of Fagus and Quercus).

15. **M. limosus** Quélet.

Spores $12 \times 5^1/_2$, pipshaped-lanceolate. Cystidia obovate, about 12 μ broad, apex warty.

Fig. specimens: Kirkeby, on dead leaves of Aira cæpitosa (boggy ground in wood, Nov. 1911, gregarious).

Very tiny an flaccid. Cap about 2 mm, whitish with a tinge of wood-colour, stem only $^1/_4$ mm thick.

16. **M. graminum** (Lib.)

Spores $8—12 \times 5$ μ, narrowly pipshaped.

Fig. specimens: Sanderum in bog, on dead grass, gregarious, Juli 1897. It differs from no: 15 by the tile-red cap and the fuscous (not blackish) stem. Rare.

[I have met a form of this species (?), (Kerteminde, on Agrostis alba, on lawn, Aug. 1917) differing from the main type by somewhat larger and paler cap (only the central part tile-reddish), at first with a small papilla but soon umbilicate (number of gills 6—13). The spores were somewhat smaller ($9^1/_2—10^1/_4 \times 4^1/_4—4^1/_2$ μ) and no cystidia to be found. This probably is *M. Curreyi* (B. et Br.), Cooke's Illustr. pl. 1130; but it is rather too close to M. graminum to deserve specific rank. Cooke's conception of the graminum-group appears to me altogether somewhat ambiguous. M. graminum (as I conceive it) he describes sub nom. *Mycena juncicola* Fr., while his figure and description of M. graminum (loc. cit. pl. 1129) depicts quite another agaric (with globular, minute spores).]

### β. PERFORANTES.

17. **M. androsaceus** (L.)

Spores $7 \times 3^1/_2$ μ, ellipsoid-pipshaped.

Fig. specimens: Tommerup, on dead branches of Picea in dense plantation, June 1898. Not uncommon, especially on Calluna, on heaths, but also on needles of Pinus etc. In damp places it develops an aerial mycelium consisting of black, hairlike creeping strings.

18. **M. perforans** (Hoffm.) Fr. (*M. abietis* (Batsch).)

Spores $5—7 \times 3^1/_3$ μ, pipshaped.

Fig. specimens: Årup, on dead needles of Picea, Oct. 1896. Very common, and often very numerous; always springing from a single needle.

19. **M. recubans** Quélet.

Spores $10—13 \times 4^1/_2—5$ μ, fusiform-ellipsoid. Cystidia cylindric, omewhat ventricose, total length about 40 μ, breadth 7—10 μ.
s

Fig. specimens: Hjallese, solitary on the petiole of dead leaves of Quercus (rarely on Salix capræa), Sept. 1898. Not rare, but always solitary.

This little tiny plant is easily overlooked or mistaken for a small Mycena (from which it is most easily recognized by the bay-brown stem). It appears to be very nearly related to *M. saccharinus* Batsch, from which it differs by broader gills, sulcate cap without papilla and darker stem. My plant deviates from the description of Quélet by having the lower portion of the stem sparsely clad with long, woolly, minute hairs (not tomentum) and by larger spores (Quélet says 6—7 μ). By these two characters it approaches M. saccharinus which seems to be intermediate between M. recubans and M. epiphyllus.

20. **M. epiphyllus** Fr. (*M. squamula* Batsch).

Spores $10 \times 4^1/_2$ μ or $10—12 \times 3^1/_2—4$ μ, pipshaped-lanceolate. Cystidia awlshaped (free portion about 30 μ long). Hairs on stem 250—600 μ.

Fig. specimens: Hjallese on petioles and dead shoots of Populus canadensis, Oct. 1896. Rather common, often numerous, especially on leaves and petioles of Fraxinus, on boggy ground.

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For figures of spores, cystidia etc. vide the plate.

# THE GENUS RHODOPHYLLUS.

All the pink-spored agarics with angular spores are so intimately related — especially with regard to their microscopic characters — that like Quélet and Schroeter I think it right to unite them in one genus, regarding *Entoloma*, *Leptonia* etc. as subgenera only. And for this genus I adopt the Quéletian name *Rhodophyllus.* — Schroeter coined the name *Hyporhodius* (adapted from the Friesian tribal name *Hyporhodii*) for the same purpose, but his name is less appropriate as the Hyporhodii of Fries include also smooth-spored agarics, f. inst. *Pluteus* and *Volvaria.*

When the nature of the spore is thus made the leading character of this genus one of the Friesian subgenera (*Clitopilus*) must needs be split up, as it includes smooth-spored species as well as angular-spored ones. While the smooth-spored species can probably be shifted to *Paxillus* (at least such species as *C. Prunulus* and *C. mundulus*) all the angular-spored species (of which I know anything) can fairly well be transferred to *Eccilia*, without materially altering the natural limits of this subgenus.

Of course in doing so you impair the parallelism which Fries tried to establish between the whitespored series and the pinkspored one (*Tricholoma—Entoloma*, *Clitocybe—Clitopilus* etc. But this parallelism evidently is more apparent than real.

Although the *Rhodophylli* are very uniform with regard to their anatomical structure (they all have large, subventricose and somewhat protruding basidia with long sterigms, rarely any characteristic cystidia etc.) there is one leading microscopic feature which comes very useful for purposes of classification, viz. the form of the spore. Nearly all the species can be placed within two groups: the one with almost isodiametric the other with heterodiametric spores. The first type of spore is subglobular, generally more or less acutely 5-(6-) angular; the second ovate or oval, more or less angular or wavy. To the former belongs the majority of the *Entolomas* (*Genuini*

and *Nolanidei* of Fries) besides some few species of *Nolanea* and *Eccilia*. To the latter the group *Leptonidei* of *Entoloma*, all the *Leptonias* and the majority of the *Nolaneas* and *Eccilias*. Besides these two types (with small variations within each type) we have in *Nolanea pascua* (and some few other species) a third: the quadrangular-stellate or almost cruciform spore.

2-spored basidia are rare. *Nolanea cetrata* is constantly twospored (as already observed by Schroeter). In *Leptonia chalybæa* the number appears to vary (even on the same gill) from two to four, three being the ordinary number. In the specimens of *L. euchlora* which I have investigated the number of sterigms was 2—3 (but I have only found this species once).

Cystidia are rarely met with; and when present they are generally very trivial: hairshaped or subcylindric.

Classification. The numerous species of the genus *Rhodophyllus* represent comparatively few types. Many species are almost too intimately related to deserve specific rank. This is especially true of the *Entolomæ Nolanidei* Fr. From *E. clypeatum* through *E. rhodopolium*, *E. nidorosum* etc. to *E. speculum* all the species form a chain of almost imperceptible links. And when this holds true of the living plants themselves the case is of course still worse when it comes to recognizing and distinguishing species from figures and descriptions. In the figure the minutiæ which characterize the different species (shades of colour, villosity etc.) are either entirely lost or accentuated out of all proportion. — It is therefore rather difficult to attain to a fully correct identification and naming of the species found. Still I hope that my list will not show many serious mistakes.

The number of Danish Rhodophylli appears to be comparatively large. The number of species found and figured by me is 47 (besides some few species which I have not found in a condition fit for portraying). — FRIES in Hymenomyc. Europ. enumerates 69 species (including the angular-spored Clitopili and Eccilias) which he has seen himself. And RICKEN (loc. cit.) has about eighty (besides some dubious natives) for all Central Europe. — The species mentioned by me are not all the Danish Rhodophylli. SEV. PETERSEN (loc. cit.) describes several species — f. inst. *Leptonia formosa*, *L. solstitialis*, *Nolanea cocles*, *N. vinacea* and *Eccilia parkensis* — which I have not met with. Thus probably the total number of Danish Rhodophylli is considerably above 50.

# KEY

## TO THE SPECIES OF THE GENUS RHODOPHYLLUS FIGURED IN »DANMARKS AGARICACEER«.

### I. ENTOLOMA Fr.

**A. Ovisporæ** (Leptonidei Fr.)

Spores heterodiametric. Cap not hygrophanous, more or less flocculose or fibrillose, dry.

α. Stem bluish-fuscous, everywhere with darker, minute, flocculose scales . . . . . . . . . . . . . . . . . . . . . . . . . . 1. *R. dichrous.*

β. Stem fibrillose.

a. Cap campanulate, umbonate.

1. Gills whitish, Stem subfuscous with dingy purplish-rubescent fibrils . . . . . . . . . . . . . . . . . . 1. *R. porphyrophæus.*

2. Gills of a sordid-gray colour. No trace of red on stem. 3. *R jubatus.*

b. Cap convex or slightly depressed . . . . . . . . 4. *R. griseo-cyaneus*

**B. Subsphærosporæ.**

Spores isodiametric. Cap smooth.

α. Genuini Fr. Cap not hygrophanous, subviscid.

a. Cap and stem with a tinge of blue. . . . . . . . . . . 5. *R. madidus.*

b. Cap whitish or alutaceous. No trace of blue.

1. Not umbonate. Cap very large (up to 20 cm). Gills yellowish . . . . . . . . . , . . . . . . . . . . . . . . . . 6. *R. lividus.*

2. More or less umbonate. Cap smaller. Gills not yellowish.

* Cap convex, umbonate, medium-sized (5—8 cm) 7. *R. prunuloides.*

⁑ Cap conic-campanulate, 3–4 cm . . . . . . . . 8. *R. repandus.*

β. Nolanidei Fr. Cap hygrophanous.

a. Cap not viscid.

1. Large and fleshy. Cap subumbonate, lurid or sordid gray . . . . . . . . . . . . . . . . . . . . . . . . . . . 9. *R. clypeatus.*

2. Slightly fleshy.

* Stem rather long (longer than width of cap).

† Cap not white.

○ Cap rather large, pallid gray or livid

§ Stem white. Cap obtuse . . . . . . 10. *R. rhodopolius.*

§§ Stem livid. Cap conic, expanding . . . 11. *R. turbidus.*

○○ Cap smaller, dingy date-brown. Stem grayish

§ Umbonate . . . . . , . . . . . . . . . . . . . 12. *R. majalis.*

§§ Not umbonate . . . . . . . . . . . . . . . 13. *R. nidorosus.*

†† Cap whitish . . . . . . . . . . . . . . , . . . . . . 14. *R. speculum.*
⁑ Dwarfy: small and short-stemmed.
† Cap coarsely striate half way up, not silky 15. *R. elaphinus* var.
†† Cap even or very minutely striate.
○ Cap with a silky lustre, roe-brown to umber. Odour mealy. Gills even . . . . . . . . . . 16. *R. sericeus.*
○○ Cap pitch-brown. Odour faint. Gills transversely veined . . . . . . . . . . . . . . . . . . . . . . . 17. *R. costatus.*
b. Cap small, slightly viscid, sepia. Stem very slender, pallid . . . . . . . . . . . . . . . . . . . . . . . . . 18. *R. Batschianus.*

## II. LEPTONIA Fr.

A. Edge of gills black or dark blue.
α. Edge blue. Growing on stumps . . . . . . . . . . . . . . . 1. *R. euchrous.*
β. Edge black. Growing on the ground. . . . . . . . . . . 2. *R. serrulatus.*
B. Edge of gills not darker than face.
α. Stem not yellow or white.
a. Gills at first pure white. Stem dark blue.
1. Cap sepia-brown, squamulose . . . . . . . . . . . . . 3. *R. placidus.*
2. Cap blackish-blue, velvety-flocculose in the middle 4. *R. lampropus.*
b. Gills bluish or sordid.
1. Gills at first bluish. Stem dark blue . . . . . . 5. *R. chalybæus.*
2. Gills dingy. Stem glaucous or brownish . . . . . 6. *R. asprellus.*
β. Stem yellow or white.
a. Stem yellow, turning greenish coerulean when touched. 7. *R. euchlorus.*
b. Stem white. Cap whitish or slightly ochraceous . 8. *R. sericellus.*

## III. NOLANEA Fr.

A. Spores 4-(5-) angular, stellate or almost cruciform
α. Cap large (2—4 cm) . . . . . . . . . . . . . . . . . . . . . . 1. *R. pascuus.*
β. Cap small (1—1½ cm) . . . . . . . . . . . . . . . . . . . . 2. *R. bryophilus.*
B. Spores not quadrangular-stellate.
α. Spores heterodiametric (subovate).
a. Basidia 2-spored (whole plant with a tinge of ochraceous) 3. *R. cetratus.*
b. Basidia 4-spored.
1. Plant not yellowish or pallid.
* Tall (8—11 cm) . . . . . . . . . . . . . . . . . . . . . . 4. *R. hirtipes.*
⁑ Smaller (Stem less than 7 cm).
† Gills pure white when young . . . . . . . . . . . 5. *R. infula.*
†† Gills fuscous or pale umber.
○ Cap glabrous, 1½—2 cm.
§ Cap papillate. Stem rigid, polished. Gills not thick. . . . . . . . . . . . . . . . . . . . . . 6. *R. mammosus.*
§§ Stem short, fuscous, not shining. Gills thick . . . . . . . . . . . . . . . . . . . . . 7. *R. clandestinus.*
○○ Cap minutely fibrillose, very small (less than 1 cm) . . . . . . . . . . . . . . . . . . . . . . . 8. *R. fumosellus.*

2. Plant yellowish or pallid.
   * Whole plant more or less yellowish . . . . . . 9. *R. icterinus.*
   ⁑ Cap very small, pallid . . . . . . . . . . . . . . . . 10. *R. minutus.*

β. Spores isodiametric (subglobate-angular).
   a. Cap and stem not bluish.
      1. Cap (and gills) fuscous, radiately striate . . . . . . 11. *R. junceus.*
      2. Cap pallid. Gills incarnate-whitish (vide R. minutus, no: 10).
   b. Cap and stem with a glaucous tinge . . . . . . . . 12. *R. coelestinus.*

## IV. ECCILIA Fr. (ext.).

(including the angular-spored *Clitopili*).

A. Spores heterodiametric (subovate).
   α. Whole plant white or alutaceous.
      a. Stem slender. Cap convex, subdepressed. Gills subdecurrent . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1. *R. carneo-albus.*
      b. Stem rather short. Cap convex-umbilicate. Gills decurrent . . . . . . . . . . . . . . . . . . . . . . . . . . . . 2. *R. cancrinus.*
   β. Cap brownish or fuscous.
      a. Stem short, not cartilagineous . . . . . . . . . . . . . . . 3. *R. undatus.*
      b. Stem rather long (twice width of cap or more).
         1. Cap subsquamulose-tomentose. Stem fibrillose. 4. *R. Mougeotii.*
         2. Cap smooth. Stem polished, glabrous.
            * Cap about 2 cm. Gills sligthly decurrent. 5. *R. griseo-rubellus*
            ⁑ Cap 1 cm or less. Gills narrow, strongly decurrent. 6. *R. nigrella.*

B. Spores isodiametric (subspheric).
   α. Gills sordid. Cap dark umber or soot-brown . . . . . 7. *R. rusticoides.*
   β. Gills whitish. Cap pallid with pale fuscous coarse striæ. 8. *R. rhodocylix.*
   [Spores very small (about 5 $\mu$ in diam.) almost spheric: vide Clitopilus (Paxillus) popinalis.]

## V. CLAUDOPUS Fr.

Cap reniform, sordid gray; paler and silky when dry. Stem very short . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1. *R. byssisedus.*

# SYSTEMATIC AND FLORISTIC NOTES.

## I. ENTOLOMA.

### A. **OVISPORÆ** (LEPTONIDEI FR.).

1. **R. dichrous** (Pers,)

Spores $9—10^1/_2 \times 6^1/_2—7$ μ, ovate, obtusely angular. Basidia 4-spored. Edge of gills formed of cylindric-hairshaped, 6—7 μ broad cells. Squamules on stem made up of cylindric, up to 9 μ broad cells with bluish-gray content.

Figured specimens: Husmandsskolen near Odense, on the ground amongst grass and foliage in wood of Quercus and Corylus, solitary, Oct. 1919.

This species is very well characterized by the bluish-fuscous stem, all over sparsely set with minute blackish flocci. Ricken (loc. cit.) gives a very good description of it. It has a habitual likeness to *Tricholoma terreum*.

2. **R. porphyrophæus** Fr. (*R. subrubens* Karst.)

Spores $10—12 \times 6$ μ, obtusely angular-wavy. Cystidia inflated, large, flask-shaped, occasionally with a roundish head.

Fig. specimens: Hesbjerg near Tommerup, growing aggregately in a meadow in wood of Fagus, Oct. 1901. Also found at Langå (Jyll.) in similar locality, 1914.

I do not see any real divergence between *porphyrophæus* and *subrubens*. Fries places R. p. in *Genuini*, but it is related to R. jubatum, and the spores also indicate its proper place to be in Leptonidei. — Karsten (Symb. ad Mycol. Fenn. VI) describes the stem (of R. subrubens) as hollow, at first furfuraceo-squamulose then glabrous, the gills as white, turning sordidly incarnate. Fries (Icones selectæ) has (for R. porphyrophæus) »lamellæ primo griseo-albidæ, dein sporis griseo-rubellæ« and »stipes nudus sed impolitus, opacus . . . solidus«. In my specimens the stem was slightly furfuraceo-squamulose and fibrillose-striate with a very narrow cavity, the gills at first white then dusky incarnate. These differences appear to me too slight to make good any claim to specific distinction for the two.

3. **R. jubatus** Fr.

Spores 9—$10^1/_2 \times 5^1/_2$—6 μ, outline oval (base obliquely pointed) wavy-angular.

Fig. specimens: Near Blåkilde (by Arden), in short, mossy grass in a meadow, Sept. 1900.

Differs from no: 2 by the dark gills, smaller dimensions and total want of any trace of red on stem. Cooke's figure (loc. cit. tab. 317) is more like *R. porphyrophæus.*

4. **R. griseo-cyaneus** Fr. var.

Spores $9^1/_2$—11 × 7—8 μ, wavy-angular.

Fig. specimens: Between Lindved and Hollufgård, boggy ground amongst Carices, Hypna and Mnium, Sept. 1902.

This is not the typical form, which I have met in several other places (Rudme, Sept. 1912 and Sanderum Aug. 1909) always in grass on peaty ground, and which is characterized by a convex, not depressed cap with a tomentose (only very slightly flocculose) coating and almost free gills (without hairshaped cells on the edge). — The form here figured forms a transition to *R.* (*Eccilia*) *Mougeotii* (vide pag. 39), and is possibly not specifically distinct from this species. It is very much like Cooke's figure of *Ag. ardosiacus* (loc. cit. tab. 328), which most authors consider a synonym of R. Mongeotii. — I add a brief description of my plant: Cap 2—$4^1/_2$ cm, convex, slightly depressed, dingy lilac, central part becoming paler and discoloured, everywhere minutely tomentose-squamulose. Stem 4—6 cm, attenuated upward, base white, apex lilac-gray, fibrillose, subfistulose. Gills white, adnate, almost plane, turning rosy. It appears to be rather close to *R. (Entoloma) Rozei* Quél.

## B. SUBSPHÆROSPORÆ.

### α. GENUINI FR.

5. **R. madidus** Fr.

Spores 7—8 μ in diam., almost spheric, obtusely pentangular.

Not figured. — I have only met with this characteristic species once (at Bellinge, grassy slopes near river, Oct. 1908). It is very well distinguished from all other species by the stout, steel-blue, striate-fibrillose stem.

6. **R. lividus** (Bull.) (*R. sinuatus* Fr.)

Spores $7^1/_2$—10 μ in diam., subspheric, obtusely 5-(6-)angular.

Fig. specimens: Tommerup, in wood of Quercus and Fagus, on moist clayey ground. (Also in Trelle skov, near Fredericia, Sept. 1910 and at Langesø by Odense (wood of Quercus) Sept. 1915.)

The cap in my specimens was yellowish alutaceous, smooth,

not fibrillose. It has a faint smell (of fresh meal or raw cucumber). — Like Schroeter I see no real difference between *R. lividus* and *R. sinuatus*.

7. **R. prunuloides** Fr.

Spores 8—10 × $7^1/_2$ μ, globose-ovate, obtusely angular.

Fig. specimens: Hjallese, under Populus on roadbank, solitary, June 1898. (Also on old common near Nyborg (»Øen«), Sept. 1905, and at Dalum, on grassy slopes towards river, Sept. 1905.)

8. **R. repandus** (Bull.)

Spores about $7^1/_2$ μ in diam., almost spheric, obtusely 5-(6-) angular. Basidia 4-spored.

Fig. specimens: Tommerup, in grass on green slope between wood and bog, Sept. 1908. (Also at Langesø, near Odense, in similar locality Oct. 1914. — The cap is slightly viscid at first, when dry somewhat shining or glossy. The gills are crowded, emarginate-free. It has a faint odour of fresh meal or raw cucumber.

β. NOLANIDEI FR.

9. **R. clypeatus** (L.)

Spores 8—10 × $7^1/_3$—8 μ, outline spheric or globular-oval.

Fig. specimens: Odense, on the ground in orchard, gregarious and subfasciculate, June 1898. Rather common in May and June, under hedges etc.

It has a distinct »mealy« odour. Specimens with paler cap and more pallid-whitish gills — which are not uncommonly to be met with — form a transition to R. rhodopolius.

10. **R. rhodopolius** Fr.

Spores 10—$10^1/_2$ × 7—8 μ, obtusely pentangular, ovate-subglobular. Basidia 4-spored.

Fig. specimens: Vissenbjerg, wood of Fagus, Sept. 1908. — Common, generally gregarious, but never fasciculate. The typical form is chiefly to be met with in woods of Fagus.

An absolutely sterile form, with pure white, abnormally ruffled and curled gills, is occasionally found.

11. **R. turbidus** Fr. (?) var.

Spores 9—10 × $6^1/_2$—7 μ, irregularly (6-)angular, broadly ovate.

Fig. specimens: Lundeborg, wood of Quercus, Aug. 1917.

Typical specimens of R. turbidus — answering to Fries' description and figure (Icon. sel. I) — I have never seen. But the form here portrayed (which I refer to R. t.) I have met in several places, especially under Betula on boggy ground. It is very close to R. rhodopolius, perhaps only a variety of this species. I add a brief description:

Cap 4—$7^1/_2$ cm, conical, at last expanded and rather acutely umbonate; flesh thin. The colour resembles that of darker forms of *R. rhodopolius*. The edge is somewhat striolate. Stem somewhat clubshaped, tall and rather slender, 9—10 cm × 4—8 mm (above) and 6–10 mm (below), striate, paler than the cap (recalling R. (Nolanea) pascuus). Gills rather narrow, somewhat distant, free or almost free, at first pallid, then light trout-red. Odour none.

12. **R. majalis** Fr.

Spores 7—10 × 7—8 μ, subspheric, 5-(6-)angular.

Fig. specimens: Hjallese, in copsewood, gregarious, May 1902. Cap dingy date-brown, margin striolate, with a distinct umbo. Stem striate, of a pale watery-gray colour, slightly hollow.

13. **R. nidorosus** Fr.

Not figured. Plants answering to the description of R. n. are rather common in moist and close copsewoods, especially on boggy ground under Salices. It is almost too close to no: 12, only differing in want of umbo and in having a more pronounced »nitric« odour. The stem is generally more slender. Microscopically there is no difference.

14. **R. speculum** Fr.

Spores 9 × $6^1/_2$—7 μ, spheric-oval, irregularly 5-(6-)angular.

Fig. specimens: Hjallese, gregarious in wood of Corylus and Quercus, Sept. 1908. Not uncommon. — My plants differ from the description of Fries in having a (very faint) nitric odour. Intermediate forms between 13 and 14 occur.

15. **R. elaphinus** Fr. (?) var. **radiatus** (nov. var.)

Spores 8—$9^1/_2$ × 7—$7^1/_3$ μ, subglobular-ovate, obtusely angular.

Fig. specimens: Fruens Bøge, edge of a young plantation of Fagus, Oct. 1902 (and Aug. 1903).

Cap slightly fleshy, $1^1/_2$—$2^1/_2$ cm, convex-expanding, with a small, rather acute umbo, hygrophanous, coarsely radiato-striate half way up, pale dingy date-brownish. Stem short (3 cm), pallid, slightly hollow. Gills horizontal, rounded behind, pallid.

This species is the smallest and most dwarfy form of the series which begins with *R. clypeatus* and includes no: 9—15, all of which run into each other without any distinct lines of demarcation. — My plant differs very materially from the type of Fries (gills not so broad, cap less fleshy, somewhat umbonate, colour lighter etc.) and forms a transition to *R. sericeus*.

16. **R. sericeus** (Bull.)

Spores 8—10 × 6—7 μ, irregularly and obtusely angular, subspheric-oval.

Fig. specimens: 1) Trolleborg, drive in wood, amongst grass and moss, Sept. 1900; 2) Hjallese, on old lawn, Sept. 1900. — Common.

Rather variable. Fig. 1 represents the comparatively slender and light-coloured form which is occasionally mistaken for *R. (Nolanea) pascuus*, from which it is easily distinguished by the subspheric, obtusely angular spores and the »mealy« odour.

17. **R. costatus** Fr. var.

Spores 7—8 × $6^1/_2$—7 μ, subspheric-pentangular.

Fig. specimens: Hjallese, permanent pasture-field, Nov. 1899 (and 1914), subfasciculate.

Not very well distinguished from dark forms of no: 16. My plant had a (very faint) mealy smell. The stem was not white-squamulose above as indicated by Fries. By its pitch-brown colour and the rather small spores it formed a transition to Ent. *Cordæ* Karst.

18. **R. Batschianus** Fr.

Spores $6^1/_2$—$7^1/_2$ × 6—$6^1/_2$ μ (or $6^1/_2$ × $5^3/_4$) almost spheric, slightly angular. Cystidia absent. Basidia 4-spored. Sporedust very pale incarnate.

Fig. specimens: Kirkeby, wood of Picea, on mossy ground, Oct. 1914. Also found in Håre Bjerge, Oct. 1906 and 14, and at Hesbjerg, Oct. 1912 in similar localities.

This species differs very much from all other Entolomas which I know. It has the slightly viscid cap of the *Genuini*, but it is somewhat hygrophanous. The almost sootbrown, small cap (which is minutely striate at the margin) and the long and slender stem reminds one of *Nolanea*, the at length somewhat depressed cap and the at last sligtly descending gills recall *Eccilia* — My plant belongs to the second type of Fries (with whitish gills).

## II. LEPTONIA.

1. **R. euchrous** (Pers.)

Spores 9—11 × 5—$7^1/_2$ μ, oval or ovate, obtusely angular-wavy.

Fig. specimens: Hjallese, 1) solitary on stump of Corylus, Sept. 1897; 2) gregarious on stump of Alnus, Oct. 1899. — Not uncommon.

When examined by means of a pocket-lens the stem is seen to be dusky with minute violet fibrils.

2. **R. serrulatus** (Pers.)

Spores 8—11 × 6—7 μ, ovate-oval, with 5—8 rather sharp angles. Basidia 4-spored (in B.). Cystidia clavate, 11—12 μ broad, fasciculate, pale gray (1909).

Fig. specimens: A) Flensborg, grassy slope on rather sandy

soil, Sept. 1900. B) Nyfæste near Arup, amongst grass and heather, on sloping ground, Oct. 1900. — Not common.

Very variable. A) forms a transition to *Eccilia atrides* (which as Fries says is hardly specifically distinct). The gills had a long decurrent tooth; the cap was black, shining (sunburnt). In B) the gills were extraordinarily broad, semicircular and broadly adnate. The stem had no black points above, but black striæ formed of the decurrent edge of the gills. — In other cases the cap is rather profoundly umbilicate, even when young. But I do not think these differences sufficient for establishing several distinct species.

The figure af Cooke (loc. cit. tab. 333) is without the blackish edging and altogether different from what I call R. s. It looks like a form of *R. (Entoloma) griseo-cyaneus* or *E. ardosiacus* (Quélet).

3. **R. placidus** Fr.

Spores 9—10 × 6—$6^1/_2$ μ, obtusely angular-wavy.

Fig. specimens: Trolleborg, around stump of Fagus, in grass Sept. 1900. Not uncommon, on and around old stumps of Fagus.

In the figured specimens the stem was minutely striate, not white-pruinate above.

On decaying stump of Fagus (Hjallese, Oct. 1909) I have met with another, considerably stouter form of this species: Cap up to 4 cm broad, mousegray-brownish, fibrilloso-squamose. Stem short, curved, coarsely striate, (almost grooved) blackish-blue.

The very large form which Fries figures (Icon. sel. tab. 97) with squamose cap and the stem all over set with darker squamules is more like *R. (Entoloma) dichrous*.

4. **R. lampropus** Fr.

Spores $9^1/_2$—$11^1/_2$ × $6^1/_2$—7 μ, irregularly oval, nodulose; (also 10—13 × 7—8 μ).

Fig. specimens: Vissenbjerg, amongst grass and heather, on hillslope outside a plantation of Picea, Aug. 1905. Here and there in similar localities.

The figured specimen was rather slender-stemmed and blackish-blue, almost like no. 5, except for the white gills. In other places I have met with more short-stemmed specimens and also with a form with rather profoundly umbilicate cap.

5. **R. chalybæus** (Pers.)

Spores 10 × 7 μ, irregularly ovate, about 6-angular. Basidia generally 3-spored (but varying, even on the same gill, from 2- to 4-spored. Cystidia 0.

Fig. specimens: Hollufgård, in copsewood (Betula, Prunus Padus etc.), gregarious, Sept. 1917. — Also found at Krabbesholm, Sept. 1917 (in wood of Fraxinus and Alnus).

6. **R. asprellus** Fr.

Spores $11^1/_2 \times 7^1/_2$ μ, oval, angular. Basidia 4-spored.

Fig. specimens: 1) Sanderum, boggy meadow, amongst grass, July 1897; 2) Bramstrup, in a mossy bog, July 1897. — Rather common. The stem varies in colour (brownish, bluish gray etc.).

7. **R. euchlorus** (Lasch)

Spores $10^1/_2$—$13 \times 7$—8 μ, irregularly angular, broadly or narrowly ovate. Basidia with 2 or 3 long sterigms.

Fig. specimens: Border of main road between Korinth and Høbbed, in grass, Oct. 1900, gregarious.

My specimens differed from the description of FRIES in having a smooth stem. When bruised the flesh (especially that of the stem) becomes verdigris-skyblue. — This species (which Fries only knew from herbaria and figures) is hardly distinct from the Friesian species *R. (L.) incanus.*

8. **R. sericellus** Fr. (Entoloma s.)

Spores $11$—$11^1/_2 \times 7$—$7^1/_2$ (or $9$—$10 \times 7$ μ), broadly ovate, rather angular.

Fig. specimens: 1) Skørping, old grass-field, Sept. 1897; 2) Årup, border of road in wood, Sept. 1898. — 2) is a slender form from a shady place, a transition to *R. (Eccilia) carneo-albus.* — Common in old grassfields etc., especially on light soil.

Like other modern authors I place this species in *Leptonia*, although it has no near relations here, but rather in *Eccilia.*

## III: NOLANEA.

### A. SUBSTELLATÆ.

1. **R. pascuus** (Pers.)

Spores $9$—$10 \times 7$—9 μ, 4—6-angular, with prominent angles or almost stellate Basidia 4-spored.

Fig. specimens: Gelsted, amongst moss and grass, green walk in wood of Picea, Oct. 1906. Rather common, especially in open spaces in coniferous plantations, rarely met with in frondose woods. In open pastures a more dwarfy and somewhat lighter form occurs.

Some French mycologists apply the name *R. proletarius* Fr. to this species; but as Fries (»Monographia« I p. 293) expressly states that R. proletarius is characterized by its cap being »*medio villosus et umbrinus*« I must needs disagree from this opinion. The same authors reserve the name R. pascuus for the species here described sub nom. *R. cetratus* Schroeter, which

to my mind is not the typical R. pascuus of Fries but probably identical with the plant mentioned in his »Monographia« as a pinophile distinct variety of R. pascuus, or probably a distinct species.] —

2. **R. xylophilus** nov. spec.

Spores $10 \times 8^1/_2$ μ, irregularly angular-stellate.

Fig. specimens: S. Næra, on rotten stump of Fagus, Sept. 1901. Also on stump of Corylus, Hjallese, Oct. 1909.

Although microscopically almost identical to the preceding species this little tiny plant can hardly be regarded as a variety of R. pascuus. Habitually it has much in common with R. minutus Karst. (no: 10). I add a brief diagnosis:

*Pileus 1 cm latus, convexus, pellucido-striatus, pallidus (pars centralis subfusca, striis isabellino-argillaceis, leviter in incarnato vergentibus). Stipes 4 cm × 1 mm, subpellucidus, albidus. Lamellæ liberæ, albæ, dein pallide roseo-incarnatæ. Sporæ ut supr.*

## B. NODULOSÆ.

### α. OVISPORÆ.

3. **R. cetratus** (Fr.?) Schroeter.

Spores $10^1/_2$—$11 \times 7$—$7^1/_2$ μ, subovate, obtusely angular-wavy. Basidia always 2-spored.

Fig. specimens, Kirkeby, amongst moss and sticks in wood of Picea, Oct. 1904. Not uncommon in coniferous woods.

This species is often confounded with *R. pascuus*, but it is easily recognized by its microscopic characters. Macroscopically it differs in being more slender, with a slight tinge of ochraceous all over. The description of Fries does not fit very well, and besides his plant is said to grow »in fagetis«, what the species here mentioned never does. Saccardo says the spore is »4-apiculatis«, an observation which probably refers to a form of R. pascuus.

4. **R. hirtipes** (Schum.?) J. E. Lange = *R. mammosus* Ricken (nec Fries).

Spores $10$—$14 \times 7$—$8^1/_2$, ovate or oval, rather obtusely angular. Basidia 4-spored. Cystidia hairshaped.

Fig. specimens: Hjallese, in wood of Quercus, Corylus etc., solitary, Oct. 1895. Not uncommon in similar localities.

Ricken describes this plant very well sub nom. (N.) mammosus Fr., but it is not at all like the Ag. mammosus figured in Icones selectæ The habitat also differs, as Ag. mammosus is said to grow »in locis apricis, graminosis«, while my plant grows in dense and rather moist copsewoods. — To my mind the *Ag. hirtipes* figured in Flora Danica represents this species,

although it is said to grow »in silvis inter folia pinea putrescentia«. The chief characters of this plant are as follows: Cap conic-convex, with a minute, at last disappearing, papilla, 2—4½ cm broad, somewhat pellucido-striatulate, dingy brownish (when dry paler and silky). The edge of the cap extends a little over the gills and is at first somewhat inflexed. Stem tall (8—12 cm), slender and straight, silky, striate, paler than the cap, slightly thickened towards the base which about 2 cm up is clad with a pure white cobweb-like tomentum. Gills ventricose, almost free, at first whitish then incarnate-pallid. It has a faint smell of cucumber.

5. **R. infula** Fr.

Spores 8—9 × 6 μ, oval, rather prominently angular-wavy. Basidia 4-spored. Cystidia 0.

Fig. specimens: Sanderum, boggy pasture, Aug. 1909. Not uncommon.

This species has much in common with no: 6, but the gills are pure white at first, then rosy-incarnate.

6. **R. mammosus** (L.?) Fr.

Spores 9½—10½ × 7—7½ μ, subovate, obtusely angular-wavy. Basidia 4-spored.

Fig. specimens: Gerup, near Holstenshus, amongst grass, border of road through wood of Picea, Aug. 1902. Not uncommon, especially on hill-slopes etc. My plant is identic with the form figured by Fries (Icones selectæ). What the larger form mentioned in the text as figured by Bulliard is, I do not know (vide no: 4). — *R. papillatus* Bres. is probably identical.

7. **R. clandestinus** Fr.

Spores 11—12½ × 7—7½ μ, oblong, irregularly wavy-angular. Basidia 4-spored.

Fig. specimens: Våsemose near Holmstrup, grassy slope outside a wood, Sept. 1902. — My plant differs somewhat from other descriptions of R. c., and I therefore add a short diagnosis:

Cap about 1½ cm, at first conic-convex, then slightly depressed with a small papilla, sootbrown, indistinctly striate (when dry silky-fibrillose, grayish-brown). Stem short, comparatively stout. (2—3 cm × 2—3 mm), grayish-brown, hollow, smooth and even. Gills thick, distant, broader towards the stem and broadly adnate, grayish-brown. Smell none.

8. **R. fumosellus** Wint.

Spores very large (14—18 × 7½—9 μ), oblong-ellipsoid, wavy-angular. Basidia 4-spored.

Fig. specimens: Lykkesholm, in a bog under Alnus, Sept. 1909, solitary. Cap 0,9 cm, conic-convex, coarsely pellucido-striate, sootbrown, sparsely clad with minute, pallid, flocculose fibrils. Stem 4 cm × 1 mm, of the same colour, with pallid, minute

flocci above and flocculose-fibrillose below. Gills distant, broad, sootbrown (at last with a rubescent tinge from the spores) broadly adnate, slightly emarginate with a decurrent tooth, edge not darker than face. This last character and the distant gills are the only differences between my plant and the description of Winter (Saccardo V no: 2996), and I do not think them sufficient for considering it specifically distinct.

9. **R. icterinus** Fr.

Spores 8—12 × 7 μ. Cystidia (in figured specimens) rather short, somewhat nodulose hairshaped. (In other finds 0.)

Fig. specimens: I: Odense, on boggy ground in park under Alnus, Oct. 1896. — Rather common in similar localities. It has a faint, but very characteristic fragrant smell (almost like pineapples).

9a. **R. i.** forma *gracillima* J. E. Lange.

Spores 9—10 × 7 μ, subovate, with rather prominent angles. Cystidia 0.

Fig. specimens II: in a grassy ditch under hedge, Vasemose near Holmstrup, Sept. 1902. Differing only in being smaller (cap 1 cm) and very-slender (stem 6 cm × 1,5 mm).

Intermediate forms are often met with. The cap is often almost devoid of yellow, rather pallid and watery dingy incarnate, with a fulvous tinge at the top. Such forms, which especially occur late in the season after the first frosty nights, might be referred to *Ag. pleopodius* (Bull.), which Ricken takes to be identical with *Ag. verecundus* Fr. But the characteristic smell (first noted by Schroeter, but not observed by Ricken) makes me believe they are only reduced forms of R. icterinus.

10. **R. minutus** Karst.

Spores 9—10 × 7—7½ μ, 5-(6-)angular.

Fig. specimens: Pederstrup, on boggy ground in wood, under Alnus, gregarious, Aug. 1902. Also found at »Egeskov«, Sept. 1916.

Cap 1—1½ cm, plano convex, slightly umbilicate, minutely striate to umbilicus, pallid, striæ a little darker (dingy drab or pale brownish), umbilicus darker. Stem slender (3—5 cm × 1½ mm), brownish, apex paler, even, base slightly white-fibrillose. Gills whitish then rosy-incarnate, somewhat adnate. — The spores are sometimes almost spheric (as indicated by Karsten) and it might therefore be sought under β. But I place it here in the vicinity of R. icterinus, with the smaller forms of which it has much in common.

β. SUBSPHÆROSPORÆ.

11. **R. junceus** Fr.

Spores 8½—10½ × 7½—8 μ, subspheric, obtusely 5-(6-)angular. Basidia 4-spored.

Fig. specimens: Hjallese, wood of Fagus, Oct. 1904. — Not common, generally solitary, in moist woods.

The form *cuspidata* figured by Fries (Icon. sel.) with an acute, very prominent umbo I have never met. My plants are convex or somewhat campanulate, obsoletely umbonate. It is a very distinct species on account of its almost spheric spores, its subfuscous, very coarsely striate cap and the broad, dusky gills.

12. **R. coelestinus** Fr.

Spores 8—9 × 7 μ, obtusely 5-(6-)angular, spheric-ovate. Basidia 4-spored.

Fig. specimens: Tommerup, pasture on ground sloping towards bog, outside a wood, Nov. 1907.

My specimens differ from the description of Fries in not having the centre »scabrello« and the stem at first not fistulose By the subspheric spores it can easily be distinguished from the bluish Leptonias. The cap is bluish-fuscous or dingy steelblue (when dry: dark steelgray and silky).

## IV. ECCILIA.

### A. OVISPORÆ.

1. **R. carneo-albus** Wither. *(Clitopilus c.)*

Spores 8—11 (generally 10—11) μ long, subovate, irregularly and obtusely angular.

Fig. specimens: Korsør, on hedgerow in wood of Fagus, Sept. 1902. — Also at Rold (Jylland), Hesbjerg (Fyn) etc., always in woods. A dwarfy form, cap only 3 mm broad, is also met with.

It is extremely close to *R. sericellus* and hardly deserves specific rank. The only differences are the somewhat decurrent gills and the slender stem. Occasionally the cap is almost snowwhite. Altogether it might be characterized as an etiolated, silvan form of R. sericellus.

2. **R. cancrinus** Fr. *(Clitopilus c.)*

Spores 10—13 × 7—7½ μ, ovate or oval, irregularly wavy. Basidia 4-spored.

Fig. specimens: Kerteminde, sandy pasture near the coast, July 1909. — Also at Sanderum, pasture on boggy ground, Aug 1909.

Differing from no: 1 chiefly in the depressed, subinfundibuliform cap, shorter stem and strongly decurrent gills.

3. **R. undatus** Fr. (*Clitopilus u.*)

Spores $8^1/_2$—$9^1/_2$ × $5^1/_2$—6 μ, oval, irregularly wavy.

Fig. specimens: I) Rønningesøgård, roadside in park, amongst grass and moss, Sept. 1902; II) Kerteminde, pasture on sandy ground near coast, Sept. 1905. Not common.

My plant differs from the description of Fries in not having a hollow stem; but in the excellent figure in Fries' Icon. sel. tab. 96 the cavity is also wanting. The agaric figured by Cooke (loc. cit. pl. 486) sub nom. *Ag. undatus* evidently has nothing to do with Fries' species. And *undatus* Fr. sensu Ricken is a smooth-spored species referred by him to *Paxillus*. — Fig. II represents a more membranaceous and infundibuliform variety, almost answering to Fries' description of * *Ag. viarum*. A still more reduced form is:

3 b. **R. undatus** var. *pusillus* J. E. Lange.

Spores 9 μ long, subovate, with about 6 obtuse angles.

Fig. specimens: Hjallese, on naked soil under hedge, roadside in wood, Aug. 1907, gregarious.

Cap $^1/_2$—$1^1/_2$ cm, plano-convex, profoundly umbilicate, indistinctly striate, dingy pale gray, at first slightly hoary-pruinose (especially towards the edge). Stem paler than cap, not hollow, at first slightly pruinose, 1—2 cm × $1^1/_3$ mm, base slightly white-woolly. Gills rather strongly decurrent, dingy pallid, moderately crowded, arcuate, soon with a pallid-incarnate tinge. Sporedust very pale incarnate.

Although this little tiny plant at first sight does not at all recall R. undatus, the var. *viarum* connects them very intimately, and I therefor refrain from making it a distinct species.

4. **R. Mougeotii** Fr. var.

Spores 10 × 7 μ, obtusely angular, ovate. Edge of gills set with hairshaped-cylindric, 6—8 μ broad, obtuse cells.

Fig. specimens: Bramstrup Mose, in boggy meadow, July 1902.

This plant is very closely related to the form of *R. (Entoloma) griseo-cyaneus* figured and described pag. 29. Perhaps it is only a sunburnt form of the same species

Cap convex, at first umbilicate, then somewhat infundibuliform, $2^2/_3$—3 cm, dark gray-violet, everywhere hairy-tomentose-squamulose. Stem 4—5 cm × 3 mm, steelgray-lilac, hollow, somewhat fibrillose and with indistinct blackish flocci. Gills adnate, at last somewhat decurrent, whitish then pink.

5. **R. griseo-rubellus** Lasch.

Spores 9—10 × 7—$7^1/_2$ μ, broadly ovate, wavy-angular with about 6 angles. Basidia 4-spored.

Fig. specimens: Vormark, Falleskov, growing gregariously in grass, open space in plantation of Picea, Sept 1905. (Also found on sloping ground outside a plantation, at Gelsted, Sept. 1912.

Central part of cap slightly squamulose. Stem smooth, glabrous. Gills at first whitish, rather distant, horizontal, adnate and slightly decurrent.

5 b. **R. g.** var.

Spores longer (10—13 × 7—8 μ).

Fig. specimens: Bramstrup mose, on boggy ground, July 1903. Stem slenderer and paler, but for the rest not differing materialy from the type and probably only a palustrine form.

6. **R. nigrella** (Pers.?) Quél.?

Spores 9—12 × $6^1/_2$—$7^1/_2$ μ, ovate (subspheric or oblong) irregularly wavy-angular.

Fig. specimens: Dalum Landbrugsskole, solitary in a garden, bed of hardy perennials, July 1898.

As I have only seen a single specimen of this characteristic little agaric I am not in a position to decide its systematic position. Probably it is identic with what Quélet called R. nigrella Pers. (Saccardo V no. 3027). As his description is very brief I give here my own diagnosis: Cap 1 cm broad, infundibuliform, fuscous (becoming blackish), edge striate. Stem smooth, subfuscous-steelgray with a slight violet tinge, somewhat fistulose, $2^1/_2$ cm × 2 mm. Gills narrow, strongly decurrent, incarnate Flesh steelgray.

## B. SUBSPHÆROSPORÆ.

7. **R. rusticoides** Gill.

Spores 8 × 6 μ, subspheric 5-angular.

Fig. specimens: 1) Håre Bjerge, sandy hillslope amongst lichens, grass and Sarothamnus, Oct. 1907; 2) Hjelmerup, sandy hedgerow, Oct. 1915. —

This very distinct species — which Fries did not know — appears to me very nearly allied to his *Agaricus parkensis* (especially as represented in his figure (Icon. sel. I) in which the gills are fuscous (while in the diagnosis they are said to be whitish).

8. **R. rhodocylix** (Lasch).

Spores 8—10 μ in diameter, subspheric 5-angular. Basidia 4-spored. Cystidia coarsely hairshaped.

Fig. specimens: Højsholt near Tommerup, on decaying stump of Betula in boggy wood, Sept. 1908. Also found at Sandager, growing in a bog under Alnus and Picea (on the ground amongst dead needles), Aug. 1913.

[Under Subsphærosporæ also might be sought *Clitopilus popinalis* Fr. which has very small, almost spheric spores (about 5 μ in diameter), but which probably should be transfered to *Paxillus*.]

## V. CLAUDOPUS.

1. **R. byssisedus** (Pers.)

Spores about 9 μ long, obliquly ovate, wavy-angular. Basidia 4-spored. Cystidia 0.

Fig. specimens: Høbbed, near Korinth, edge of wood amongst foliage, Nov. 1901. — Also at Våsemose, on decaying stump (of Fagus) in wood, Oct. 1915. — My plants were not resupinate at first. The (very short) stem is almost lateral

For figures of spores etc. vide the plate.

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# SPECIFIC INDEX.

# EXPLANATION OF PLATE.

All spores magnified 800 times, cystidia and basidia 300 times. — The numbers correspond to the current no: of each species in the text. All figures are from fresh material, no dried or otherwise preserved specimens ever used. — For most microscopical observations only an ordinary objective (dry system, focal distance 3,2 mm) is used.

## PHOLIOTA.

1. P. Vahlii . . . spore
2. » caperata . —
3. » erebia . . . — basidium
4. » dura. . . . — cystidia
4a. » » vermiflua — cystidium
5. » præcox . . — —
6. » togularis . —
6a. » » filaris —
7. » teneroides — basidium, cyst.
8. » destruens . —
9. P. radicosa. . . spore, cystidium
10. » adiposa . . .
11. aurivella. . . —
12. » squarrosa . . —
13. » flammans . . — cystidia
14. » spectabilis. . —
15. » mutabilis . . —
16. » marginata . . —
17. » unicolor . . . — cystidium
18. » mycenoides . — —

## MARASMIUS.

1. M. urens . . . . . . spore
2. » fuscopurpureus —
3. » putillus . . . . . -
4. » oreades . . . . . —
5. » globularis . . . —
6. » cohærens . . . . — borst, surface-cell
7. » lupuletorum . . — cyst., borst from stem
8. » scorodonius . . -
9. » prasiosmus . . . —
10. » alliaceus . . . . — cystidium
10a. M. alliaceus var. spore, cystidium
11. » foetidus . . . —
12. » ramealis . . . —
13. » Rotula . . . . —
14. » Bulliardi . . . —
15. » limosus . . . - cystidium
16. » graminum . .
17. » androsaceus . —
18. » perforans . . —
19. » recubans . . . — cystidium
20. » epiphyllus . . —

## RHODOPHYLLUS.

(Entoloma

1. dichrous . . . . . . spore, hairs from gill
2. porphyrophæus . . — cystidium
3. jubatus . . . . . . . —
4. griseo-cyaneus var. spore
5. madidus . . . . . . —
6. lividus . . . . . . . —
7. prunuloides . . . . —
8. repandus . . . . . . —

9. clypeatus . . . . . . spore
10. rhodopolius . . . . —
11. turbidus var. . . . —
12. majalis . . . . . . . —
14 speculum . . . . . . —
15. elaphinus v. radiatus —
16. sericeus . . . . . . . —
17. costatus . . . . . . —
18. Batschianus . . . . —

(Leptonia)

1. euchrous . . . . . . —
2. serrulatus . . . . . —
3. placidus . . . . . . —
4. lampropus . . . . . —
5. chalybæus . . . . . — basidium
6. asprellus . . . . . . —
7. euchlorus . . . . . — basidia
8. sericellus . . . . . —

(Nolanea)

1. pascuus . . . . . . spores
2. xylophilus . . . . . —
3. cetratus . . . . . . spore, basidium
4. hirtipes . . . . . . spore
5. infula . . . . . . . . —
6. mammosus . . . . —
7. clandestinus. . . .
8. fumosellus . . . . —
9. icterinus . . . . . . —
9a. — var. . . . —
10. minutus . . . . . . —
11. junceus . . . . . . —

(Eccilia)

1. carneo-albus . . . —
2. cancrinus . . . . . —
3. undatus . . . . . . —
3b. — var. pusillus —
4. Mougeotii var. . . —
5. griseo-rubellus . . —
5b. — var. —
6. nigrella. . . . . . . —
7. rusticoides. . . . . —
8. rhodocylix . . . . —

(Claudopus)

1. byssisedus . . . . . —


Jakob E. Lange del.

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UDGIVET AF

DANSK BOTANISK FORENING

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BY

C. FERDINANDSEN AND Ö. WINGE

WITH 8 FIGURES IN THE TEXT

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Færdigt fra Trykkeriet den 17. Juli 1914.

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BIND 2 No. 2

# THE MARINE ALGÆ OF THE DANISH WEST INDIES

## PART II. PHÆOPHYCEÆ

BY

F. BØRGESEN

WITH 44 FIGURES IN THE TEXT

KØBENHAVN
H. HAGERUP'S BOGHANDEL
BIANCO LUNOS BOGTRYKKERI
1914

Pris: 2 Kr. 25 Øre.

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# THE AGARICS OF DENMARK

BY

**JAKOB E. LANGE**

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AMANITA. LEPIOTA. COPRINUS

WITH TWO PLATES

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DANSK BOTANISK ARKIV

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DANSK BOTANISK FORENING

BIND 2 No. 4

# A LIST OF PHYTOPLANKTON FROM THE BOETON STRAIT, CELEBES

BY

C. H. OSTENFELD

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UDGIVET AF

DANSK BOTANISK FORENING

BIND 2 Nr. 5

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AF

O. ROSTRUP

MED 3 TAVLER OG ET RESUMÉ:
CONTRIBUTIONS TO THE FUNGUS-FLORA OF DENMARK. I

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BIND 2 Nr. 6


# CONTRIBUTIONS TO WEST AUSTRALIAN BOTANY

BY

C. H. OSTENFELD

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INTRODUCTION

C. H. OSTENFELD: THE SEA-GRASSES OF WEST AUSTRALIA


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BY

JAKOB E. LANGE

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PLUTEUS. COLLYBIA. INOCYBE.

WITH THREE PLATES

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Redaktion: **L. Kolderup Rosenvinge.**

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DANSK BOTANISK FORENING

BIND 2 Nr. 8

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BY

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Redaktion: **L. Kolderup Rosenvinge.**

Færdigt fra Trykkeriet d. 22. Maj 1918.

DANSK BOTANISK ARKIV
UDGIVET AF
DANSK BOTANISK FORENING

BIND 2 Nr. 9

# MOSSES AND LICHENS COLLECTED IN THE FORMER DANISH WEST INDIES

BY

F. BØRGESEN AND C. RAUNKIÆR

KØBENHAVN
H. HAGERUP'S BOGHANDEL
BIANCO LUNOS BOGTRYKKERI
1918

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# STUDIES IN
# THE AGARICS OF DENMARK

BY

JAKOB E. LANGE

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WITH ONE PLATE

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